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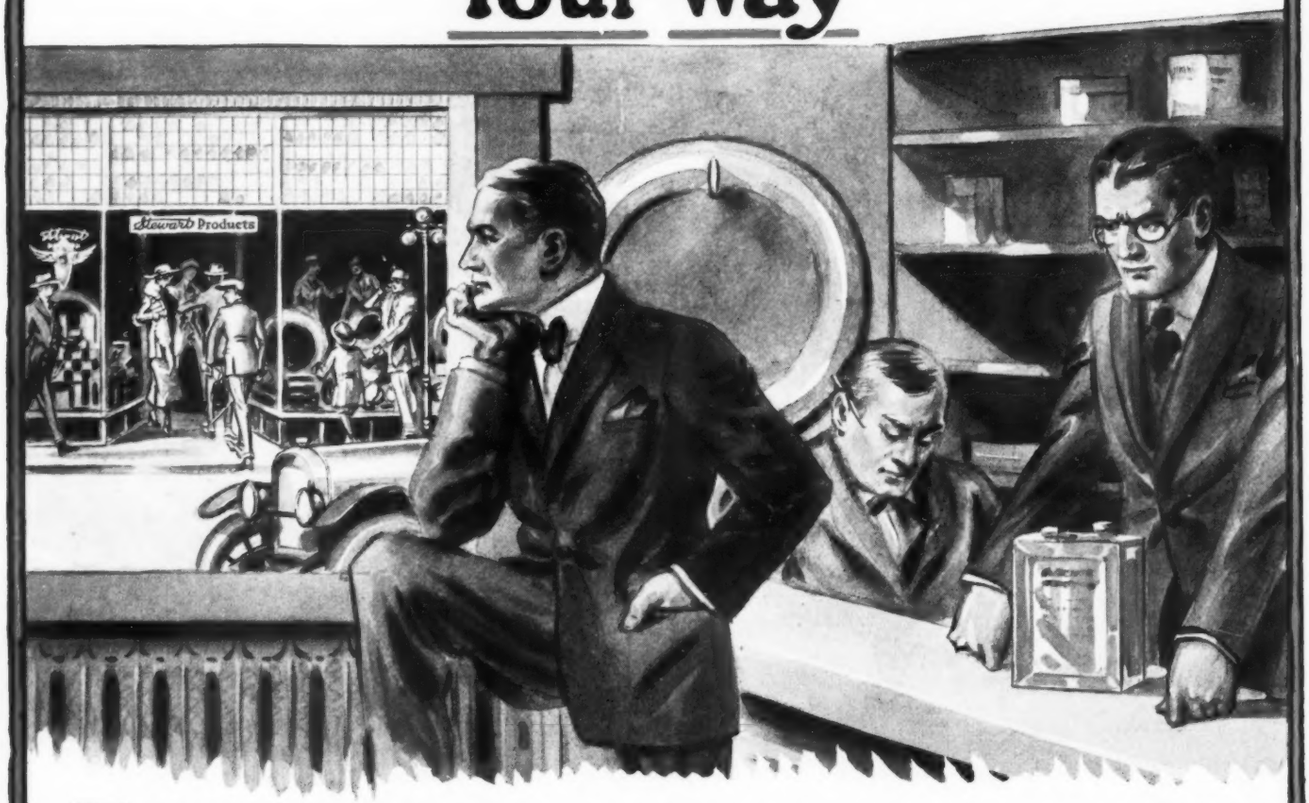

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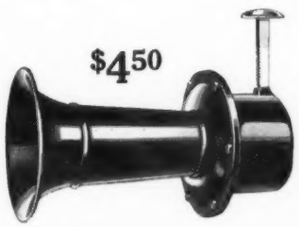

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AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

VOL. XL NEW YORK—THURSDAY, FEBRUARY 27, 1919—CHICAGO NO. 9

High Tariffs and Prohibitions Hold Industry Back

European Cars Will Benefit American Products—Internationalization of Product Needed—Need for Co-operation and Not Exclusion To-Day

By David Beecroft

NEW YORK, Feb. 25—The decision of France to prohibit the importation of automobiles for one year and the total war prohibition of England being continued indefinitely are about as sensible as our protective duty of 45 and 30 per cent on all automobiles imported into the United States. Imaginary fears and needless protection are at the bottom of the situation in all three countries.

Take the United States first: As the largest producers of automobiles and a country whose production has risen steadily until a year ago, instead of practically shutting out all foreign-built cars by our high tariff wall we would be better off to have a real liberal sprinkling of foreign-built cars sold throughout the country, yes some in each of the forty-eight states. A reduced tariff would make this possible.

The reason is not far to seek: Europe has been compelled to build with regard to the conditions of her people and surrounding conditions. The high price of fuel has given rise to the smaller engine of high efficiency. The individualistic nature of her people has led to a luxury and comfort in body design that is not known in America. The national British characteristic for reliability and roadability has resulted in a class of workmanship that is very desirable. The limited pre-war incomes of many car owners made it necessary to have vehicles of relatively low maintenance cost. Low maintenance cost has resulted in certain character of accessibility that can be imitated to advantage.

France has operated along similar lines. So has Italy. For years we have recognized the development that France and England and Italy and Germany have achieved in racing automobiles. We have liberally copied European designs in all aspects. Our industry got its foundations in these countries.

Ten or 20,000 automobiles from these countries would be a healthy leaven among the 1,500,000 automobiles our own makers are distributing annually in our forty-eight states. The value of these machines would have an influence on our automobile design. Let them come in and compete with us and if they are better than ours we have the opportunity of making such a discovery rather quickly. If they are superior we should be quick to take advantage of those designs that are responsible for such, just as it was necessary for us in automobile racing to fashion our racing machines very closely after those of Europe and endeavor to improve on the European design wherever possible or keep out of racing.

We have a much better opportunity of discovering the good qualities of these foreign machines by having a healthy supply of them in our midst, where

we can get accurate records on them on all our road conditions, than if we shut them out of our country and only get a line on them from their performances in South American countries, Africa, Australia, India, Japan, or other parts of the world. Let us meet them at home and learn of them here.

Question of Low Clearance

Some have argued that the European car cannot be used on our roads excepting in a few of our larger cities. If this is the case we have little reason to fear, but as a matter of fact, there are two sides to this argument. We argue that the low-clearance European automobile cannot possibly operate on our roads in the grain belt. The European engineers say that their clearance is such that they can operate successfully and that to have a low body on an automobile does not necessarily mean reducing the necessary clearance. We should find this out in America rather than in Chili.

European designers and manufacturers have no little fun at our expense in the matter of body design. They put it aptly when they remark: "You sit in a European car but on an American car." There is more truth in the remark than many of us wish to admit. We learned a lot from European racing cars that came to this country. The development of the Liberty aviation engine was to quite an extent due to the European racing cars that came to America in the two or three years previous to the war.

Had we shut such racing vehicles out we would have paid a heavy penalty for the prohibition. Let us be careful that we do not shut out a lot of good things in the European automobiles which while not selling anything like so cheap as ours have a lot of merit in them, and perhaps the best step in progress might be abstracting some of the good qualities from these cars, reshaping them to American production and factory methods and thus going one step farther in our great accomplishment of making a better low-priced automobile. We have much to learn in body design and Europe can teach us a whole lot.

Does Not Need Tariff Wall

American automobile makers do not need the 45 and 30 per cent tariff wall to protect them to-day. It seems gravely possible that this tariff wall has shut out more good in the way of quicker progress than it has afforded good through its scheme of protecting our makers from foreign invasion. It was necessary in early days when we could scarcely walk.

We had the high tariff walls because of cheaper European labor, but the war has altered labor costs and while we still lead in high-priced labor the difference is not so great as it was in 1914. What we lose in labor costs we more than make up in production methods and production machinery.

Looking now at the case of the British and the French as well as the Italians: The French and British have asked for complete protection by way of total prohibition in order, as they put it, to get turned around after the war. This is true with regard to many of the factories and so the rule must be for the benefit of all. But in these countries they are to-day shutting out automobiles that their people want, namely, lower-priced machines than any of the makers in these countries are preparing to produce. This does not look so much like protection for the benefit of any class of maker so much as a failure to recognize that in England and France there are tens of thousands of people who want very cheap automobiles, but which are not made for them in their own country, and which the makers are not taking definite steps to produce. In both of these countries the automobile manufacturer built for the classes more than for the masses, and yet to-day, after the war, we fail to find much greater recognition of the farmer who wants the utility car. The European post-war program by price is still for the classes, the people of wealth, rather than for the masses. Total prohibition does not remedy such a situation.

European Plants in Good Condition

The majority of these European factories are in a much better position to-day than American factories. This is particularly true speaking financially. They have been on war work for 4 years and in some cases longer. After making great factory expansion they had 2 and 3 years to make good war profits out of the expanded plants, whereas those American makers who made heavy expansion enjoyed the fruits of such for a very brief time. We have some makers who did not have 6 months production in their new or expanded plants. They got the plants but not the profits out of them.

It is quite common with the expanded French factories to write them off at the value of 1 franc, 20 cents, in the financial report of the company. This is true with many of them. It also applies to some of the British and Italian factories. These factories cannot ask for total protection through total prohibition for financial reasons, but in most cases because of lack of preparation for post-war work, and yet they do not in scarcely a case contemplate that low-priced production which they are shutting out. Their present prohibitions are preventing certain masses of their peoples from purchasing vehicles that the makers in these countries are rarely if ever planning to provide. Again the shutting out process does not appeal as a specially rational one. It is about on a par with the wall on the west side of the Atlantic.

Lock Out More Than We Lock In

Some steps in a general re-adjustment might be made to the advantage of all. There are factors in our cars that European makers want and there are factors in European automobiles that our makers are in need of. An interchange is desirable. A fair exchange never has been robbery, nor will it be in this instance. The more we apply the total-prohibition-of-cars order to merchandising the further off do we keep the exchange of ideas. The more we apply total prohibition the more we shut out automo-

biles, but also the more we shut out engineering and manufacturing experience. It becomes an international application of that threadbare epigram on the locked-door of the engineering department, namely, "we lock more out than we lock in."

The automobile as well as the motor truck, the airplane, the farm tractor, the motorcycle and the motor boat are international in their usefulness. Our automobiles from a Detroit factory go to forty countries of the world, they go to every country. The automobiles from other countries will go to every land on the globe. There are only five or six countries that have to supply all of the other countries with their automotive apparatus. The world is large and there is abundance of money in it to buy twice as many cars as are sold to-day or any day, month or year up to the present.

The major objective is to make it easier for the world to buy, operate and maintain automotive apparatus. It is not nearly so easy to-day as it should be and if manufacturers of different countries got closer together and knew more about each others products and talked the industry more it would be better for all.

An Example

Take a case in question: European makers are all installing electric starting and lighting equipment. This means a battery for each car. England has twenty-three different battery makers, nearly all of whom are working to any standard the automobile maker insists upon. France has its quota of makers and so has Italy. Some of the automobile companies are manufacturing their own batteries. Add to this the numerous battery models in America and then for a few minutes transplant yourself to Cape Town, or Sydney, or Buenos Aires, and imagine you are a dealer handling an English, a French, an Italian and an American car. Perhaps you have two or three different models of each make with a different shape of battery for each. To make it easy to operate all of the different models you sell you must carry a liberal stock of all these battery sizes on hand and in doing so you are tying up capital, and in a word you are paying the bill for this lack of international standardization, but with true business characteristic you pass it on to the consumer and he eventually pays the price. It is not so easy for that consumer to own and operate an automobile as it should be.

The Question of Tread

The situation might be analyzed further with regard to tires, spark plugs, headlights, electric bulbs, tail lights, etc.

A further case in question is that of tread. What walls of sales resistance we would be erecting if Italy undertook to merchandise export models with 60-inch treads in several countries that might insist on such. How much better for all concerned that Italy should market cars with 56 or 57-inch treads. With this there is no wall of sales resistance built up that American makers have to wage constant merchandising attacks against and vice versa.

What walls of sales resistance would be immediately knocked down if the rules of the road were internationalized just as the rules of navigation on the sea are internationalized and just as the rules of navigation in the air are to be internationalized! When different rules of the roads first sprung into use the vehicles then used could be driven on either side of the road without any changes being made, but when the motor car arrived with its steering gear it was necessary to mount it on one side for England and on another side for America. If all countries agreed on the laws of using the road a wall of sales resistance would be quite eliminated and manufacturing costs would be reduced as well as sales costs. The tail light could be then put on one side for all vehicles. It would be easier for more people to own automobiles.

Prohibition Separates U. S. and Great Britain

When the different countries in the Commonwealth of Australia built their railroad systems they built them selfishly for their own country only. New South Wales built for herself only, and Queensland and Victoria and the other political divisions did likewise. Each used a different tread so that one locomotive cannot travel over the lines in any other country. It was a beautiful scheme of exclusion and prohibition that is to-day costing the commonwealth millions annually and will continue to do so until the treads are standardized. The longer the day of transition to a standard is put off the more expensive will be the task.

The same is true of automotive apparatus. The more Great Britain shuts herself up unto herself; the more France builds walls around herself; the more Italy does; and the more the United States does, the more are all of these great producers keeping apart at the very time when they should be getting closer together. Instead of prohibition, greater interchange of ideas is needed.

America Sold to High-Gear Cars

If we are afraid to let French, British and Italian cars into our midst and they have the same attitude toward us, it is a case of all four having about the same imaginary fears. If the European car is not suited for our agricultural areas because of low clearance, lack of horsepower, and lack of high-gear performance, then it is not necessary to shut it out, because those who attempt to sell such vehicles will find out that they cannot be sold, if all these charges are true. On the other hand if we find that their lower and more comfortable automobiles are suitable for our highways then we should be quick to adopt such features and incorporate them into our designs and re-shape them for our conceptions of production. To-day America is sold to the high-gear car for every hill. Europe changes gears and claims many advantages for it.

A goodly supply of European cars might serve to convince us that some modification might be highly desirable and would not be followed by great sales resistance.

Europe is not going to be able to permanently

(*Continued on page* 506)

Experimental Design and Testing of Airplane Ribs

Testing Machine Used in Determining Wing Rib for Glenn L. Martin Company's Twin Engined Bomber Distributes Load as in Flight

By George B. Fuller and Lessiter Milburn

THE function of the rib in an airplane is to carry the load with the least possible distortion and with the proper factor of safety.

Inasmuch as no mathematical solution is readily applied to the average airplane rib, a method of experimental design was adopted to produce a rib which should meet the requirements with the least possible weight, and at the same time utilize the least possible time, labor and material expense in production.

The airplane rib is, at best, a very light and non-rigid member. The rib shown in Fig. 2 has a 94-in. chord, is ½ in. wide, weighs 11½ oz. and carries and ultimate load of not less than 555 lb. This rib was the final selection from the results of a series of tests made upon ribs of various types which were designed by approximate mathematical methods.

The conditions demanded of a rib-testing machine follow:

1—A rib-testing machine should hold the rib and apply the load in the same manner as the air load when the rib is in the wing.

2—The distribution of the load along the chord must not vary from the predetermined load grading when the rib deflects as the load is applied.

3—The machine should be so arranged that the load may be varied from zero to the breaking load, and an accurate means of measuring the load at any point must be provided.

4—An accurate means of measuring the distortion of the rib under load should be provided.

As the load on the rib varies continually with the varying angle of incidence of the wing, the most severe case was chosen. The supports of the rib, also, are not all the same. At or near the drift struts the ribs may be said to have a fixed or rigid support, while near the center of the bay, the rib supports may be considered as not being fixed, due to the spring of the beam. In these tests a non-rigid support was used

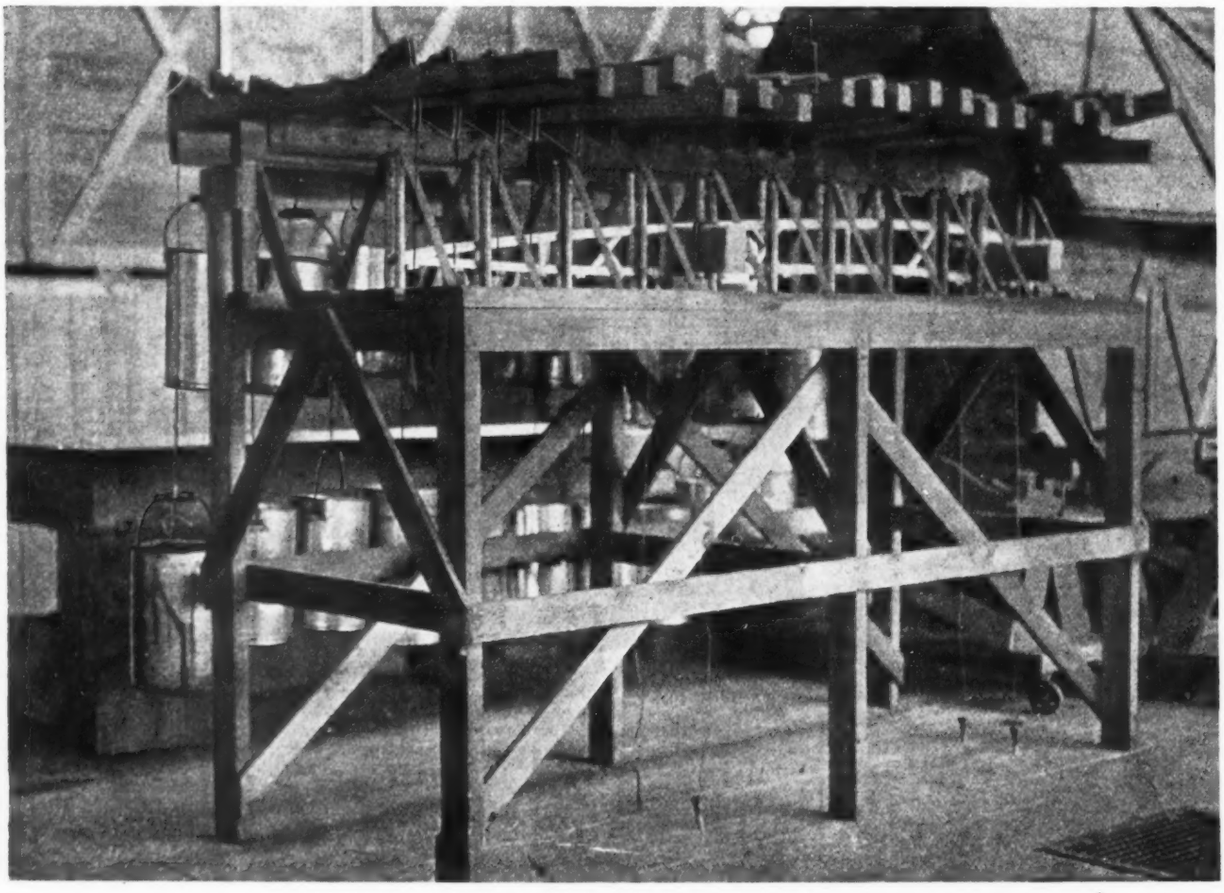


Fig. 1—General view of the testing machine with the rib mounted in place for test

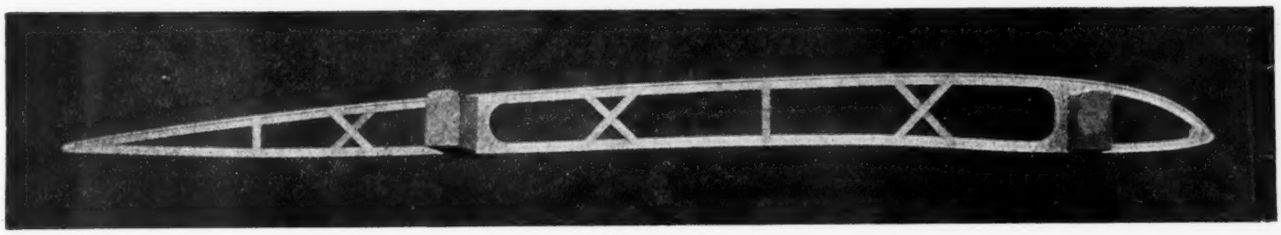


Fig. 2—The final rib selected from the results of the tests has a 94-in. chord, weighs 11½ ounces and carries an ultimate load of not less than 555 lb.

after the first five tests, to give the most severe condition.

Bearing in mind the above conditions of loading and methods of fastening, there were some five methods of applying the load to be considered, as follows:

1—A system of equalizing levers, linked together, which would distribute the load over the rib, the lengths of the levers being proportioned to give proper loads at the points required.

2—A system of loading the rib, through rubber bands of varying strength, to agree with the load-grading curve.

3—A system of springs used in the same manner as the rubber bands.

4—A system of hydraulic cylinders, the area of each being proportional to the load, as taken from the load-grading curve at the particular point, all having the same pressure.

5—A system of levers resting on knife edges, each lever being independent of any other and having its own load applied in a pail, or the like.

After a number of sketches had been made and the points of advantage and disadvantage of each of the above methods fully considered, the fifth or last method was adopted and used in all the following tests.

Description of the Machine Used

Several views of the machine are shown, in Figs. 1, 3, 4 and 5. It was constructed of wood, with a platform at about the height of a man's arm, on which the rib was to be placed. Guides of ¾-in. pipe were secured to the platform to maintain the rib in a vertical position, as shown in Fig. 4. At the rear of the platform knife edges were mounted on a horizontal beam. Over these knife edges twenty ash levers were set, each having a metal plate to take the knife edge, Fig. 3. Both ends of these levers were cut in the form of an arc, having the center at the knife edge, so that the lever ratio was always the same. At the rear end of each lever a pail was attached and the front ends were connected to the stirrups by wires, Fig. 4. The lower end of the wire was slipped through the stirrup, bent up and secured with a small washer so that the stirrups could be readily fastened to the wires. The distance from one stirrup to the next was 4.7 in. Each lever was counterbalanced with a weight, so that when the pails were empty the lever rested evenly on the knife edge.

To reproduce the condition of non-rigid support of the ribs mentioned above, the test ribs were made up on dummy spars as shown in Fig. 2. Two U-bolts were passed over each spar and connected to the floor by steel cables, leaving the spars free to move without respect to each other.

Method of Loading

The load may be applied by putting either water or sand in the pails. When the machine was designed it was intended that a water load be used. A tank was to be placed over the loading pails with twenty lines of hose, one leading to each pail. In the end of each hose a nozzle was placed having an exact diameter and calibrated for various heads. The diameters were such that the water would flow into the pails according to the ratio established from the load grading curve. The flow of water was to be controlled by a gate valve operating on all the lines of hose at the same time.

On account of delay in securing apparatus for water loading, sand loading was substituted. A small measure was made for each of the load pails, and the capacity of each cup was so proportioned that when one round of cups of sand had been poured into the pails the pull on the stirrup was in agreement with the load-grading curve chosen.

In order that the size of pail used would not be too large, it was necessary to adopt three ratios of leverage for the levers. Beginning with the leading edge of the rib, the first six levers were made with a ratio such that the pull on the stirrup was three times the load in the pail. The next seven levers had a ratio of two to one, and the last seven, one to one. The three sets of knife edges may be noticed in Fig. 3.

Operation of the Machine

The rib being assembled and secured to the dummy spars ready for test, twenty small grooved blocks were tacked along the lower edge as seats for the stirrups, to prevent crushing of the cap-strip and to simulate the sewing of the fabric to the rib, as done in the wing. The rib was placed on the platform of the machine, between the guides, and the stirrups

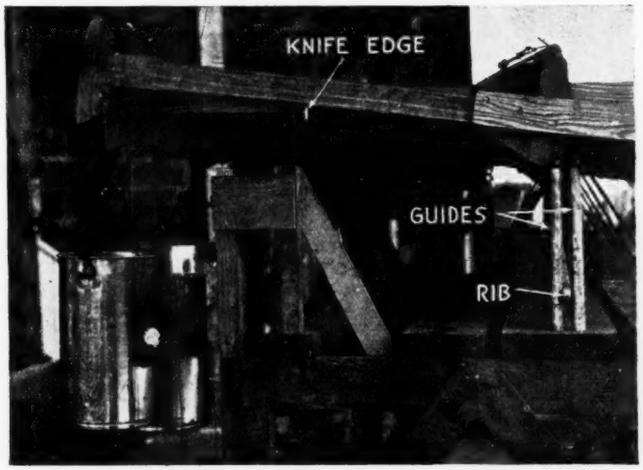


Fig. 3—Detail of airplane rib-testing machine showing the knife edge which supports the system of levers

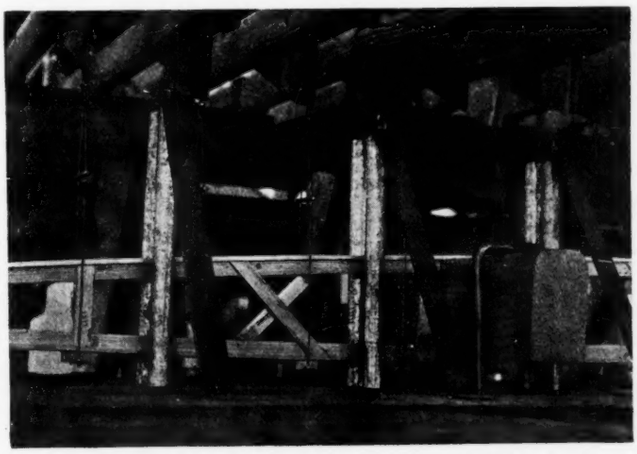
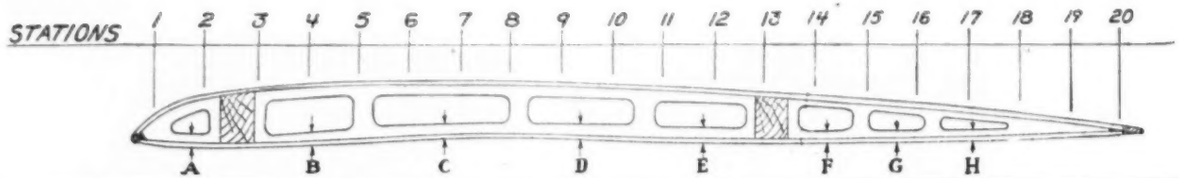


Fig. 4—Close-up showing the method of holding the dummy beams, guide bars and stirrups



Results of

Tests on Airplane Ribs

Conducted in the Glenn L. Martin Laboratory

Rib No.	Type	Web (Between Beams) Material	Grain	A	B	C	D	E	F	G	H	Portals	Tail	Nose	Capstrip-Spruce, ⅛ by	Beams Fastened	Weight, Oz.	Load Total, Lbs.	Factor of Safety	Inches Total Deflection Divided F.S. by ½	Failure Station	Failure Cause	Remarks
1	A	1/32 birch veneer	Horizontal	½	5/8	½	½	½	5/8	½	½	Cut out horizontal grain	1/32 veneer	1/32 veneer	⅛ plain	Rigidly		358	4.8		9-bottom	Shear	Method of fastening true only for ribs close to box ribs and drift struts.
2	B	1/32 birch veneer	Horizontal	½	5/8	½	½	½	5/8	½	½	Cut out, horizontal grain, with vertical side-strips	1/32 veneer	1/32 veneer	⅛ set-in	Rigidly	15	624	8.4	.077	12-bottom	Bending	Method of fastening true only for ribs close to box ribs and drift struts.
7	B	1/32 birch veneer	Horizontal	11/16	13/16	½	½	11/16	5/8	½	½	Cut out, horizontal grain, with vertical side-strips	1/32 veneer	1/32 veneer	⅛ set-in	From floor	16	383	5.2	.104	11-bottom	Shear	Humps over portals for last third of load.
8	B	1/32 birch veneer	Horizontal	11/16	13/16	½	½	11/16	5/8	½	½	Cut out, horizontal grain, with vertical side-strips	1/32 veneer	1/32 veneer	⅛ set-in	From floor	16	322	4.4	.094	13-bottom	Shear	Veneer had diagonal grain at point of failure.
9	C	1/16 spruce	Horizontal	¾	1 1/16	¾	¾	1	¾	5/8	½	Cut out, horizontal grain, with X side strips	1/16 spruce double-side strips	1/16 spruce cut-out	⅛ set-in	From floor	19½	350	4.7	.061	Portals	Shearing	Turning moment between upper and lower sides sheared portals.
10	B	1/32 veneer	Vertical	5/8	13/16	5/8	5/8	11/16	5/8	½	½	Cut out, vertical grain, with double vertical side-strips	1/32 veneer vertical grain	1/32 veneer vertical	⅛ set-in	From floor	16½	274	3.7	.135	11-bottom	Bending	Sharp failure.
12	B	1/32 veneer	Vertical	5/8	13/16	5/8	5/8	11/16	5/8	½	½	Cut out, vertical grain, with double vertical side-strips	1/32 veneer vertical grain	1/32 veneer vertical	⅛ set-in	From floor	16½	275	3.7	.136	11-bottom	Bending	Sharp failure.
13	C	1/16 spruce	Horizontal	¾	1	¾	¾	1	¾	5/8	½	Cut out, horizontal grain, with X side strips	1/16 spruce double-side strips	1/16 spruce cut-out	⅛ set-in	From floor	18½	600	8.1	.053	3-top gusset	Bending	Shape good to 450 lbs., then humped in center (secondary failure at Sta. 13).
15	B	1/32 veneer	Horizontal	¾	1	¾	¾	1	¾	5/8	½	Cut out horizontal grain, with double vertical side-strips	1/32 veneer horizontal grain		⅛ set-in	From floor	20¼	660	8.9	.050	3-bottom gusset	Bending	Humps over central portals.
16	B	1/32 veneer	Horizontal	¾	1	¾	¾	1	¾	5/8	½	Cut out horizontal grain, with double vertical side-strips	1/32 veneer horizontal grain		⅛ set-in	From floor	20¼	868	11.7	.047	13-bottom gusset	Shear	Shape good throughout, failure sharp.
17	B	1/16 spruce	Horizontal	¾	1	¾	¾	1	¾	5/8	½	Cut out horizontal grain, with double vertical side-strips	1/16 spruce, no side-strips	1/16 spruce	⅛ set-in	From floor	18½	459	6.2	.048	14-tail	Bending	Tail portals weak without side strips. Tail portals sheared at about half load.
18	C	1/32 veneer	Horizontal	½	1	½	½	1	5/8	½	½	Cut out horizontal grain, with single X side-strips	1/32 veneer, no strips	1/32 veneer	⅛ set-in	From floor	15½	378	5.1	.077	9-10 bottom	Local	Central X portals weak, and crumpled under eccentric load.
19	D	1/16 spruce	Horizontal	¾	7/8	7/8	7/8	7/8	¾	5/8	½	Built up spruce ¾x⅜ single X, wrapped and doped	1/32 veneer no strips	1/32 veneer	3/16 set-in	From floor	19¾	662	9.00	.072	3-top	Bowing of portal	Central X portals weak, and crumpled under eccentric load. Portals bowed out at about 425 lbs. load.
20	D	1/16 spruce	Horizontal	¾	7/8	7/8	7/8	7/8	¾	5/8	½	Built up ¾x3/32 veneer, double X, wrapped and doped	1/32 veneer no strips	1/32 veneer	½ set-in	From floor	17	637	8.6	.046	3-top	Bowing of portal	Front portal crumpled inward at about 575 lbs. load.
21	D	1/16 spruce	Horizontal	¾	7/8	7/8	7/8	7/8	¾	5/8	½	Built up ¾x1/16 spruce double X, wrapped and doped	1/32 veneer no strips	1/32 veneer	½ set-in	From floor	16	705	9.5	.041	3-top, web & cap.	Local	Humps over portals. X portals had a ¼" block at their cross points to bow them out in center.
22	E	1/16 spruce	Horizontal	¾	¾	¾	¾	¾	¾	5/8	½	Built up 7/16x5/16 spruce double X, & vertical	1/32 veneer no strips	1/32 veneer	½ set-in	From floor	14	533	7.2	.016	12-web bottom	Split	1/32 mahogany veneer beam gussets. Beam brace blocks partially cut away.
24	F	1/16 spruce	Horizontal	7/8	7/8	7/8	7/8	7/8	¾	¾	¾	Built up spruce 3/16x5/16 double X, & vertical	3 vertical spr. portals	1/16 spr.	½ set-in	From floor	13¼	624	8.4	.044	1-5 bottom	Shear	
25	F	1/16 spruce	Horizontal	7/8	7/8	7/8	7/8	7/8	¾	¾	¾	Built up spruce 3/16x5/16 double X, & vertical	3 vertical spr. portals	1/16 spr.	½ set-in	From floor	12¼	610	8.2	.016	3-bottom web	Splitting	Horizontal spruce beam gussets.
26	G	1/16 spruce	Horizontal	7/8	7/8	7/8	7/8	7/8	¾	¾	¾	Built up spruce 3/16x5/16 double X & vertical	3 vertica spr. portals	1/16 spr.	½ set-in	From floor	13	503	6.9	.047	3-bottom web	Splitting	Vertical spruce beam gussets.
28	H	1/16 spruce	Horizontal	¾	7/8	7/8	7/8	7/8	¾	¾	¾	Built up spruce 3/16x5/16 double X, & vertical	2 vertical spr. portals	1/16 spruce	1½ set-in	From floor	11¼	626	8.5	.046	3-4 bottom web	Splitting	Tail took strong crescent shape. 1/32 mahogany veneer beam gussets.
29	H	1/16 spruce	Horizontal	¾	7/8	7/8	7/8	7/8	¾	¾	¾	Built up spruce 3/16x5/16 double X, & vertical	2 vertical spr. portals	1/16 spruce	1½ set-in	From floor	11	665	9.0	.041	14 tail	Bending	Tail took strong crescent shape. 1/32 mahogany veneer beam gussets.
30	I	1/16 spruce	Horizontal	¾	7/8	7/8	7/8	7/8	¾	¾	¾	Built up spruce 3/16x5/16 single X & vertical Type 1	spruce, single X, & vertical	1/16 spruce	1½ set-in	From floor	11½	546	7.4	.016	3-4 bottom	Shear	1/32 mahogany veneer beam gussets.
32	Hand. Page	1/16 spruce	Horizontal	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	3/16x1/2 vertical spruce, with diag. tension strips			1½ set-in	From floor	10	436	5.9	.037	3-tension strip	Torn loose	
33	Hand. Page	1/16 spruce	Horizontal	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	3/16x1/2 vertical spruce, with diag. tension strips			1½ set-in	From floor	10	370	5.0		3-tension strip	Torn loose	
34	Hand. Page	1/16 spruce	Horizontal	Rib	No.	33 w	as	rebu	ilt w	ith s	crew	s, but did not show fair	test				10	250			3-web split		
35	I	Made in product	ion, same a	s Ri	b No	.30,	Type	I								From floor	12	615	8.3	.035	4-bottom	Bending	
36	I	Made in product	ion, same a	s Ri	b No	.30,	Type	I								From floor	12¼	451	6.1	.050	5-top	Splitting	Web at 4, 5, 6 had diagonal and spiral grain.

were attached to it. The stirrups were then attached to the levers, and the balance of the levers checked as a precaution. The four U-bolts were put on and connected to the steel cables leading to the floor, the lengths of the cables being adjusted so that all four would become taut at about the same time. The guides were fastened so that the rib would just slide easily between them. The purpose of these guides was to approximate the condition in the wing, where the ribs are cross-tied with tape and sewed through the wing every 2 or 3 in. with a stout linen cord to prevent them from twisting out of the vertical.

One round of cups, or measures, of sand of a fine, dry grade was placed in the loading pails to take up all slack in the wires, cables and stirrups. The total load on the rib at the end of one round was 41 lb., distributed in this case according to the load-grading curve shown in Fig. 6. A steel scale was placed at the center of the rib and a reading point selected and marked on the rib-web.

A second round of cups was then poured into the pails, and a reading taken on the scale, for the purpose of comparing the relative rigidity of various ribs. The loading was continued by rounds, until failure occurred, the contour, and weak points of the rib being carefully observed meanwhile, together with the readings for rigidity. At stated points during the loading, as, for instance, at normal load, at two, four, six, or eight times normal load, photographs were taken of the rib. By comparing tracings, made from these photographs, with the natural, free outline of the rib, an accurate measure of the rib contour under stated loads was obtained.

When the rib failed, the point, and probable cause of failure were noted. Fig. 5 shows a typical fracture.

After failure, the amount of sand in each load pail was carefully determined, and the weight recorded with the pail number. From these weights, the total load on the rib was checked, and also the distribution of the load by means of a

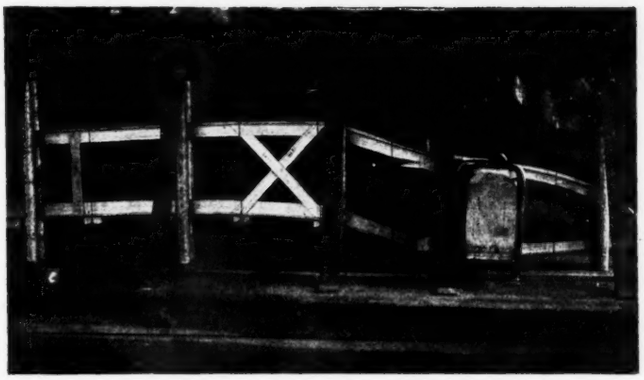


Fig. 5—Failure of rib showing the effect of spiral and diagonal grain spruce

curve, plotted with the loading points as abscissae, and the pail weights as ordinates. This curve will have the same form as the load-grading curve, if the test has been properly carried out.

The time required for test was three to five minutes, which was the disadvantage of using sand, instead of water. The water load can be applied in any time, down to about 15 seconds, by enlarging the orifices in the nozzles, or increasing the water-head.

After test, the rib was removed from the machine, detached from the dummy beams, and weighed in fractions of an ounce.

Progress in Design

The method of experimental design is at best a "cut and try method." The first five ribs were designed by approximate mathematical methods. All the others were an evolution from them by making a study of the action of the rib during the test to destruction, and either making the weak section stronger and the strong sections lighter, or by redesigning the various details of the rib, which failed, or showed extra strength, to secure the desired results.

Ten types of ribs were experimented with, nine of which are shown in Fig. 9, the tenth being the well-known Handley-Page type of rib. Thirty-four ribs were made and tested before a satisfactory rib was produced. Since production has been in progress, a number of tests have been made which are not shown in the table.

All the ribs tested were loaded according to the air loading shown in Fig. 6. This chart also shows an average typical loading, the result of a test, and gives a good idea of the small error in the loading by this method of testing. While this error may seem to be large at some stations along the chord of the rib, it is known by actual weight and no interpolation is necessary to find the load at any station.

The following table gives a complete analysis of this difference between the sand loading and the air load curve selected. The average difference over the stations is

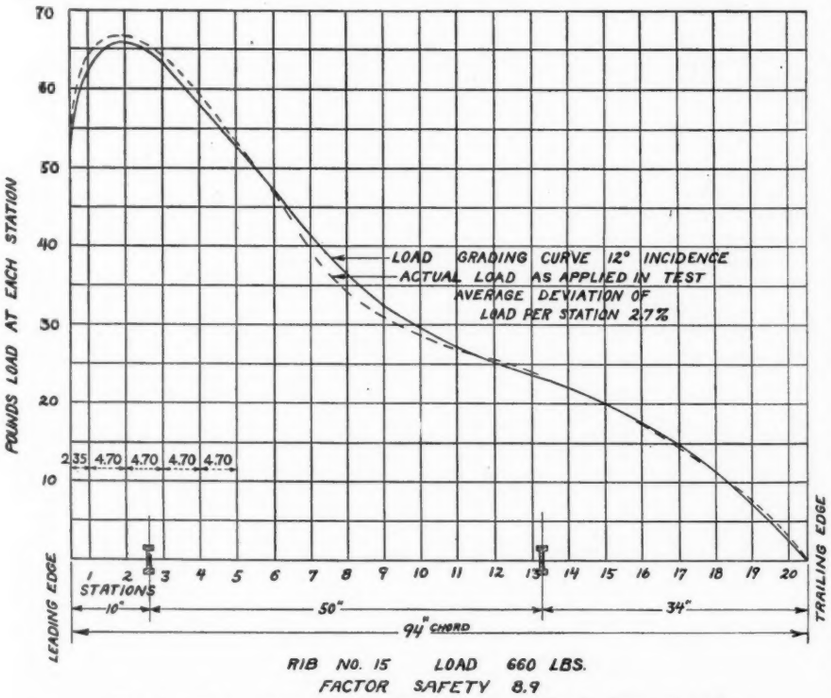


Fig. 6—Curve showing the distribution of load along the rib

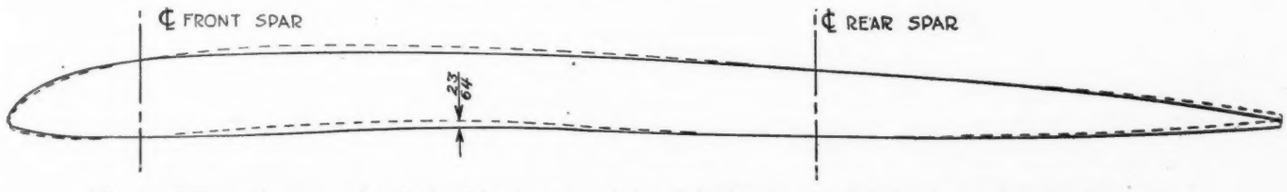


Fig. 7—Rib section to scale obtained by tracing photograph showing total deflection under distributed load

.78 lb. The average difference in per cent is 2.7 and appears largely to be due to the loading at station 20. If we neglect station 20, the average per cent of error is 1.8 per cent instead of 2.7 per cent.

Types of Ribs Tested

The large table on page 458 illustrates the various types of ribs designed and tested, and gives a complete detail of each rib as to material used and the dimensions.

Type "A" was designed along the standard type of rib generally used. It had a 5/32 in. birch veneer web with the grain of the outer ply running horizontal. The cap-strips were 3/16 x ⅝ in. selected spruce.

Type "B" is the same as Type "A," except that reinforcements were put on the web to prevent buckling. Ribs 2 to 8, inclusive, were of this same type and material, 7 and 8 being a little heavier than the others. These ribs also showed a strong tendency to bend in the horizontal portion of the rib at each portal near the vertical portion of the web.

Type "C" is the same general design as Type "B." The web in the center, nose and tail sections being of 3/16 in. thick spruce instead of 5/32 in. veneer. The "X" bracing was put on the web between each portal. In the tests this prevented the shearing of the webs and leads to the next type.

Type "D" is similar to Type "C," except that the portalled web is replaced by the "X" brace of veneer and a thin strip of spruce next to the cap-strip shaped to conform to the curve of the wing section, this strip with the cap-strip forming a "T" section. The cap-strips were reduced from ⅝ x 3/16 in. to 9/16 x 3/16 in. and again to ½ x 3/16 in.; also the web thickness has been reduced from 3/16 to ⅛ in. thick. The shape of the "X" brace will be seen. It was taped and doped to prevent any shearing tendency. Veneer gussets 3/32 in. thick on both sides of the web next to the beams are used to take up part of the bending.

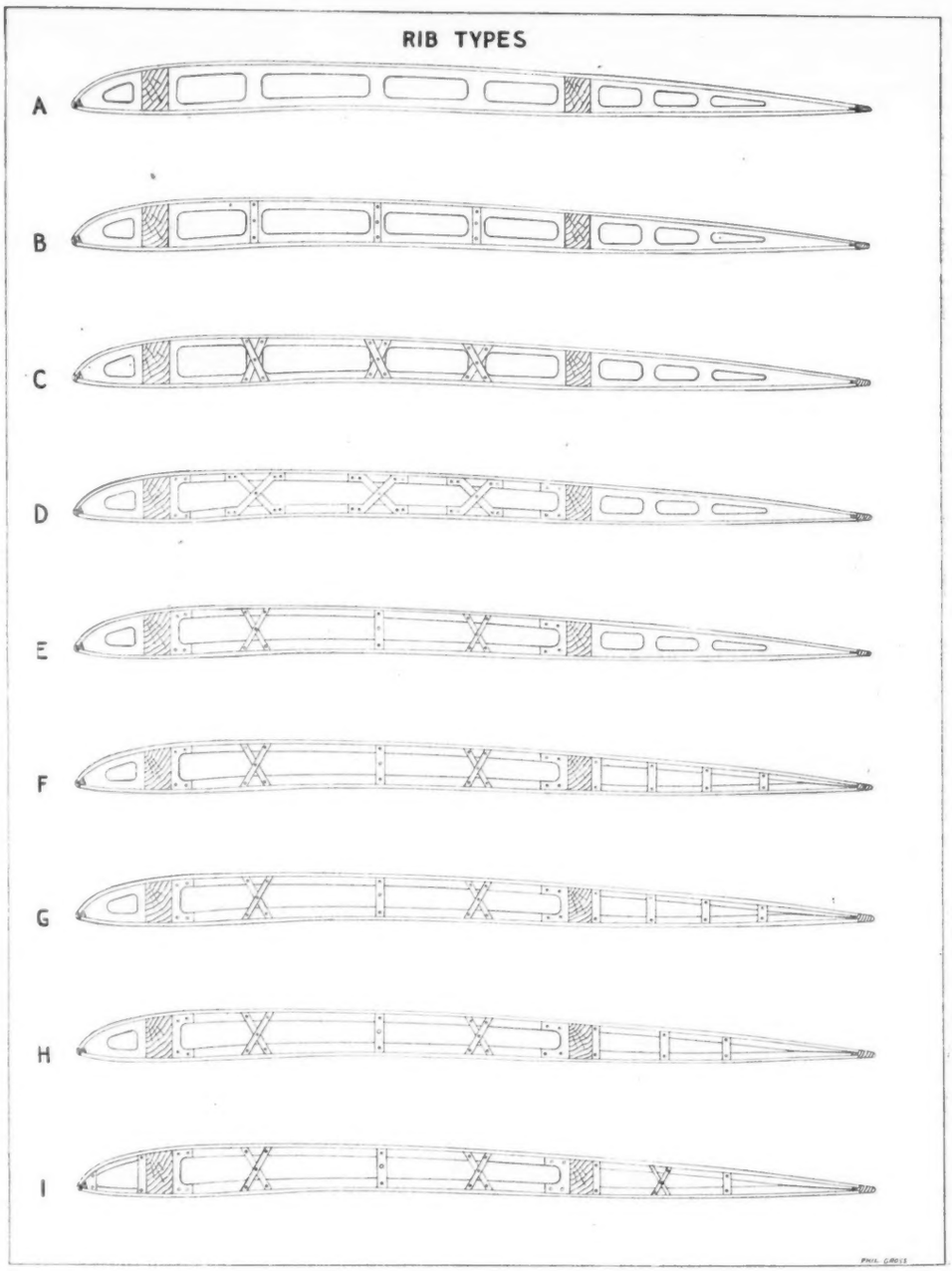


Fig. 9—Various types of ribs tested. The reference letters are those used in the table on page 458

From the table, page 458, it will be noted that the size of the cap-strips is ½ x ⅛ in., and that the central "X" brace was replaced with a vertical brace. This now makes two sets of "X" bracings in the center section. It might be noted here that the "X" bracing and the single vertical bracing are double, one on each side, separated by a block ½ x ½ x ⅛ in.

Type "F" is a marked departure from all previous types, in that the portalled section at the rear of the rear beam is replaced with a built-up section similar to the center section. Vertical grain spruce gussets were substituted for the veneer gussets next to the beams on the central section.

Type "G" is the same as Type "F," except that horizontal grain spruce gussets were used instead of the vertical grain. On trial the spruce gussets proved to be unsatisfactory.

Type "H" has veneer gussets on the central section, but had only two verticals in the tail section and, as in Type "G," the tail section took a marked crescent shape showing the necessity of an "X" brace to take the shear.

Type "I" is similar to Type "H," except that it has one "X" brace in the tail. The section in front of the front beam is built up of strips similar to the center and tail sections. This type of rib is the one used in all the airplanes so far produced by The Glenn L. Martin Co. It is made entirely of spruce, except for the four small gussets, next to the wing spars, which are 3/32 in. veneer.

Only two ribs of the Handley-Page type rib were made and tested. At this time it was decided not to carry the experiments any further, but to use Type "I" rib, as it made a very good production job and was found to be equally strong for normal flight as well as for upside down flying.

Since the table was made, a large number of tests have

(*Continued on page* 489)

Airships Practical for Commercial Use

Valuable for Trans-Oceanic Flight or for Difficult Country—Can Be Supplemented by Airplane for Short Haul Work

"A CONTINENTAL airship service could be run from Lisbon to New York, passengers being taken to Lisbon from Paris, Rome, etc., by airplane."

This is only one of the statements which appear in the report on Airships for Commercial Purposes, issued by the Air Ministry of Great Britain. Official statistics show that only one airship has been lost in England owing to catching fire in the air, although 83,360 hr. have been flown and over 2,500,000 miles covered during the war. In the case referred to the flight was an experimental one with a new type of ship, and the cause has since been ascertained and eliminated.

In a matter-of-fact way the official report of the Air Ministry covers some of the most startling developments in aerial navigation. It is impossible to read through the report without the feeling that we are just on the verge of utilizing the air as a medium of transportation to an extent which was not dreamed of before the war. When thinking of flight, it has become customary with us to think of the heavier than air machine, or airplane, but the airship has been developed to an extent which has not been generally realized, and it appears from a study of the British report that the Air Ministry is well aware of the relative advantages of each and of the particular fields in which each can do its work.

The Relative Advantages of Airships and Airplanes

In view of the different characteristics of airships and airplanes, it appears that the future uses of the two types for commercial purposes will not conflict. The airship is essentially a long-distance weight-carrying craft as compared with the short-distance high-speed airplane. It should be noted, however, that even in the matter of speed the airship of to-day with a speed of 77.6 m.p.h. can be considered slow relatively to the airplane, as she is unquestionably fast in comparison with land and sea methods of transport. In addition to this the airship has the advantage of not being dependent upon her speed through the air for her ability to remain aloft, and is not, therefore, liable to forced descent in case of engine failure, as is the airplane. Quite large repairs to engines, such as the changing of a cylinder, are possible in an airship.

The airship, then, is worthy of consideration for commercial flights over sea or land of a wooded or broken nature, such as to be unsuitable for the landing of airplanes, and on journeys involving non-stop flights of 1000 miles and upward. In addition to this, airships are the most suitable aircraft for the carrying of passengers, where safety, comfort and reliability are essential. An airship can remain aloft while engine repairs are effected; she always remains on an even keel, and there is, therefore, no danger in flying at night or in fogs or clouds, and the great lift permits of much more comfortable accommodation being provided than is possible in an airplane, there being room to move about. In the case of a rigid airship, for example, a walk of 400 or 500 ft. may be taken along the keel. The fact that the envelope is filled with an inflammable gas need not cause any misgivings as to safety, when one remembers the large number of motor vehicles which have been used during the war carrying bags filled with equally inflammable coal-gas at no greater distance from the engine than in the case of the airship.

Airship Stations for Trans-Oceanic Traffic

It appears that for commercial purposes large rigid airship stations should be established at distances of 2000 to 3000 miles apart, mainly for trans-oceanic traffic, while the airplane would be used for bringing passengers and merchandise to these from the neighboring countries. In this way the airplane would compete with the train and the airship with the steamship, over which she would have the advantage of reducing the average time of transit by at least 50 per cent. In addition to this airships would be used for linking up the railways in such places as Central Africa, where the country is difficult both for airplanes and land transport.

It is worthy of note that, though airships are generally considered to be fair-weather craft, up to the end of November there were only nine days in 1918 when no airship flight took place in the British Isles—which are notorious for possessing almost the worst weather conditions of any country in the world. The airship is able to fly on days when fog or low-lying clouds are prevalent, which might be considered unsuitable for airplanes.

Features of Latest German Rigid Airship

In long voyages, advantage could be taken of favorable winds and the routes chosen accordingly. Owing to her long endurance, an airship could afford, should a depression be met with, to fly either over or round it.

The latest German rigid airship has a disposable lift available for crew, fuel, merchandise, etc., of over 38 tons, which gives her a theoretical endurance (if all the available lift be employed in carrying gasoline) of 177.5 hr. (7 days) at a cruising speed of 45 m.p.h.—the maximum speed being 77.6 m.p.h.—during which 8000 miles would be covered. A detailed statement of the "disposable lift" available for freight of each existing type of British airship showing the gasoline consumption is attached. From these figures the freight which can be carried and the time taken over any given route can be readily worked out.

It should be noted that for purposes of short distance pleasure trips from, for example, South Coast towns, it would not be necessary to establish large stations at each town, but the following principle, which has been found most economical and successful during the war, might be adopted. This consists of building a station provided with permanent sheds, quarters, etc., at some convenient center, and forming temporary bases consisting merely of a small cheap portable shed and a few tents or huts at other places, from each of which one or two airships are run; main supplies being drawn from the "parent" station, where all large repairs are effected. In addition to the use of portable sheds at sub-stations, experiments have been carried out in mooring out airships in the open, which have had such a large measure of success as to promise well in the future.

Mooring Out Airships

An airship has been successfully moored out for six weeks in a perfectly open expanse to a specially designed mast. Only two or three men are required to look after the ship, and winds of up to 52 m.p.h. have been ridden out without any damage whatever resulting. There seems little doubt that with this system an airship could live out in the open for many months at a time. Up to the present this method has only been tried with small non-rigid airships, but it is on the point of being tried with rigids, and there seems no reason to expect other than equal success. The possibilities of using floating sheds on water are also being inquired into and appear to be promising.

It should be noted generally that greater reliability as well as decreased cost will undoubtedly be attainable by improvements resulting from careful research and experiment. For example, the use of a mooring mast will very greatly

increase the regularity of any airship service, as the chief difficulty at present consists in taking airships in and out of sheds. If an airship is left permanently ready at a mooring mast in the open it will be possible to fly in any wind up to the speed of the ship. In the same way improvements in the fabric for non-rigid envelopes and other covers of rigid airships will result in decrease in running costs by reducing the hydrogen consumption, and generally lengthening the life of the ship.

Similarly, a system of recovering water-ballast during flight would obviate waste of hydrogen by preventing the ship becoming "light," owing to the consumption of fuel during a long voyage. It will be understood that as an airship becomes light she tends to rise, which causes the hydrogen to expand, so that it must be allowed to escape through the automatic valves, or the gas-bags would be burst by the internal pressure. This tendency to rise must be counteracted by taking in weight to counterbalance that lost in the fuel consumed.

It may be of interest to note that nine airship stations of various sizes will in all probability shortly cease to be in use by the Admiralty. These will, therefore, become available for commercial purposes, though the greater part of the ground is occupied under the Defence af the Realm Act. In addition a certain number of S. S. Zero airships and coastal star airships will become available for disposal.

Comparison of Rigid Airships and Planes

During the last 4 yr. sufficient experience has been obtained in the construction and use of rigid airships to enable future developments to be forecasted with some assurance of accuracy; and it is, therefore, possible to consider the lines along which progress should be sought, and the performances which, within the next few years, can be obtained from rigid airships. In view of the widely-held opinion that the development of the large airplane will ultimately kill the large airship, it is necessary to institute a comparison between the future possibilities of both types. The result shows that in each case certain inherent qualities govern progress, and that these qualities, being widely different, will cause the two types to cover different fields of utility. It appears also that, whereas increase in size of airplanes brings many difficulties in its train with no compensating improvement in efficiency, increase in size of airships results in a reduction of the difficulties experienced at present, and gives improved efficiency, thereby opening up future possibilities of extraordinary value.

The development of rigid airships has been even more rapid than that of airplanes. In 1914 the average endurance of a German rigid at cruising speed was under one day, and the maximum full speed about 50 m.p.h. In 1918 with the German L.70 class, 2,195,000 cu. ft. capacity, the endurance at 45 m.p.h. has risen to 177.5 hr. (7.4 days) and the maximum full speed to 77 m.p.h. The ceiling has correspondingly increased from 6000 ft. to 23,000 ft. The British R.38 class (2,720,000 cu. ft. capacity) has an estimated cruising endurance at 45 m.p.h. of 211 hr. (8.8 days), 34 hr. greater than the German L.70 class. It is a matter of some difficulty to make a fair and at the same time simple comparison between the two types of transport possessing widely different qualities.

Comparison of Rigids

The figures for rigids are comparatively simple, as they are few in number and all of approximately the same class, compared to the many different classes of H/A machines which have been developed for various purposes. The Avro has been taken as the best all-round machine actually in use in August, 1914; large machines such as the Sikorski, the Caproni and the Graham-White five-seater were then only in the experimental stage, and besides did not possess the all-round efficiency of the Avro. The D.H.10a has likewise been taken as the best all-round machine in August, 1918. Although the two-engined Handley-Page and Caproni have greater endurance and weight-carrying capacity, their all-round efficiency appears inferior to the D.H.10a. The Handley-Page V gives promise of having a slightly better performance than the D.H.10a, but this machine is still in the experimental stage and reliable performance figures are not available.

Tables 1 and 2 give the progress in L/A and H/A since 1914. Table 3 shows the difference in performance between corresponding L/A and H/A craft of 1918.

IMPROVEMENT IN SHIPS AND PLANES

TABLE 1. L/A.

	August, 1914 Average figure for German Naval Zepp.	August, 1918 German L. 70	Progress Per Cent
Maximum speed at 10,000 ft.	50 m.p.h.	77.6 m.p.h.	55
Endurance at 45 m.p h.....	20 hours	177.5 hours (7.4 days)	787.5
Total lift	30 tons	66.64 tons	122
Disposal lift	8.5 tons	38.84 tons	357
Efficiency ratio	27.3 per cent	58.3 per cent	113.5
Static ceiling	6000 ft.	21,000 ft.	250
Indicated hp.....	800	2100	162.5

TABLE 2. H/A

	August, 1914 Avro	August, 1918 D.H. 10a	Progress Per Cent
Speed at 10,000 ft.....	70 m.p.h.	125 m.p.h.	78.3
Endurance	4 hours	10 hours	150
Total weight loaded.....	737 tons	4 02 tons	455
Useful load	268 tons	1.45 tons	445
Efficiency ratio	36.6 per cent	36.1 per cent	0.55 (decrease)
Ceiling	14,000 ft.	22,500 ft.	35.7
Indicated hp.	80	810	913 per cent

	August, 1914 Avro	August, 1918 Handley-Page	Progress Per Cent
Speed at 10,000 ft.....	70 m.p.h.	85 m.p.h.	21.4
Endurance	4 hours	12.5 m.p.h.	212.5
Total weight loaded.....	737 tons	5.27 tons	524
Useful load	268 tons	2.17 tons	709
Efficiency ratio	36.3 per cent	36.4 per cent	0.28
Ceiling	14,000 ft.	15,000 ft.	7.1
Indicated hp.	80	720	800

TABLE 3

Comparison of Existing H/A and L/A Machines

August, 1918	H/A D.H. 10a	L/A German L. 70	Percentage Superiority Per Cent
Speed at 10,000 ft.....	125 m.p.h.	77.6 m.p.h.	H/A 61.1
Cruising endurance	14 hours	177.5 hours	L/A 1167
Total lift (weight loaded)...	4.02 tons	66.64 tons	L/A 1557
Disposal lift (useful load)...	1.45 tons	38.84 tons	L/A 2580
Efficiency ratio	36.1 per cent	58.3 per cent	L/A 61.5
Ceiling	19,000 ft.	21,000 ft.	L/A 10.5
Indicated hp.	810	2100	L/A 159

It will be seen that at the present time the largest rigids in commission have over 10 times the total lift of the corresponding H/A, and that the disposal lift is about 25 times greater. The proportion of useful lift compared to gross lift is much higher in airships than in airplanes. An approximate figure for an airplane of average engine power is one-third, while in a rigid the useful lift available for fuel, crew, passengers, freight, etc., is well over one-half. In the case of L.70 the figure is 58.3 per cent, although this ship is the most heavily-engined and fastest airship yet built. It cannot be too strongly emphasized that many of the advantages apparently possessed by H/A at the present time result from their relatively small lift. Thus, by airplane of 60 tons total lift, if found to be possible at all, would certainly be very much less convenient to land and handle on the ground than airplanes of existing sizes, and would require overall dimensions about twice those of the largest existing machines.

It is important to note that in H/A there is no automatic improvement in efficiency resulting from greater dimensions. In L/A, on the other hand, such an automatic improvement

takes place to a very marked degree. The reason for this difference is as follows: In similar H/A machines of different dimensions, the total lift, air resistance, and b.h.p.—other things being equal—all vary nearly as the plane areas, i. e., as the square of the liner dimensions.

It follows that the ratio $\frac{\text{weight of machinery}}{\text{total lift}}$ does not vary much with size of machine. The ratio $\frac{\text{weight of structure}}{\text{total lift}}$ tends to increase with size of machine. Unit area of wing surface can only exert a definite lifting effect, and as the machine increases in size it is necessary to increase proportionally the weight of each preceding unit area of wing surface to make the machine proportionally strong. A point is finally reached where every additional unit of wing surface results in as much increased weight as its lifting effect, so that any further increase in size will involve a definite falling off in the total lifting capacity of the machine. A further small increase in size can be effected by increasing the number of planes; but, owing to the inefficiency of middle plane surfaces, due to the blanketing effect of the top and bottom planes, the resulting gain in endurance will not be large, and it will only be effected at the price of a loss in efficiency.

The theoretical property of structure may, to a certain extent, be modified by the material used. Thus, in airplanes, there is a certain size of machine which can be built most economically of wood. Any machine of smaller or larger size entails a certain proportion of uneconomical weight, due to the inherent qualities of the material. This question of material applies equally to rigids; thus, for ships of 2,000,000 to 4,000,000 cu. ft. capacity, duralumin is the most suitable material for hull structure, while for ships of 8,000,000 to 10,000,000 cu. ft. capacity a saving in weight can be effected by the use of steel. In H/A machines, therefore, all round efficiency, as measured by the ratio of $\frac{\text{disposable lift}}{\text{total lift}}$ tends to decrease with greater dimensions. Greater efficiency will, therefore, not result from increase in size, but, on the contrary, great increase in size will not be attainable until greater efficiency has been first obtained by progress in design and materials. In other words, increase in size in H/A craft will be the result and not the cause of increased efficiency.

Benefits from Increase in Size of Airships

In L/A the total lift varies as the cube of the linear dimensions, while the air resistance and b.h.p.—other things being equal—vary as the square of the linear dimensions. Hence the ratio $\frac{\text{weight of machinery}}{\text{total lift}}$ decreases automatically.

The proportion of useful lift compared to gross lift is much higher in airships than in airplanes. An approximate figure for an airplane of average engine power is 33 per cent, while in a rigid the useful lift available for fuel, crew, passengers, freight, etc., is well over 50 per cent.

It is concluded that in H/A increase in size without loss in efficiency must result from, and be limited by, the extent of improvement in design, etc. The tendency will, therefore, be to confine airplanes to moderate dimensions, except where large size is rendered necessary by the need of reducing the number of units employed upon a particular service, or by other causes, such as where long-distance non-stop flights are necessary. The outstanding characteristics of H/A will, therefore, remain as at present: high speed, handiness, moderate lift, independence of all weather conditions except the worst. As regards L/A, the functions now performed by the smaller airships will be usurped more and more by H/A. Airships may be expected to develop in the direction of increased size to a limit which is not yet in view. The outstanding characteristics of L/A will be reasonably high speed, very long endurance, great weight-carrying capacity for freight, stores, passengers, etc.

The practical range of all types of aircraft carrying mails, passengers, or merchandise, will be small compared with their maximum range given in these notes, which is calculated for calm air, and assumes, besides, that all the disposable lift (useful load), aside from crew, food, emergency water ballast, etc., is available for fuel. For transport purposes, allowance must be made for the commercial load and additional fuel over and above that actually required for the given flight, which must always be carried in case unfavorable weather is encountered. Actually, the practical range will not be much more than one-fourth of the maximum range.

Summarising, therefore, it would appear that the line of policy to be adopted is to develop the airplane for transport over distances under, say, 500-800 miles, and the rigid airship for trans-oceanic and possibly trans-continental flights of this length.

Large Airships

To obtain a reasonable performance with a small ship, every effort has to be made to save weight, and complicated built up girders must be used owing to their property of forming a light and strong joint. In a large ship, owing to the increase in efficiency with size, it would be possible to sacrifice a certain amount of lightness in construction for the sake of simplicity in design. With increase in size, steel could be used with advantage in place of duralumin, and a great saving in cost effected thereby. With increase in size, too, it should be possible to produce a rigid of so much more rugged construction that it might even be erected in some form of roofless dock, remain either moored out or in flight while in commission and only return to dock for a complete refit, thus saving much of the expense of housing stations. Just as with H/A craft, where airplanes have gradually increased in size, checked and modified in each successive stage by the results obtained under service conditions; so the construction of the really large rigid must be approached systematically, in successive stages, checked and modified at each stage by practical results.

Bad weather will not appreciably endanger a rigid in flight, and its chief operational handicap has so far been the probability that it will sooner or later be caught out in a high wind lasting for a longer period than the endurance of the ship, so that the ship would then have to attempt to land before the wind dropped and would probably be wrecked. If the meteorogical reports for previous years are examined it will be seen that even under unfavorable conditions it will be possible for a ship with a three weeks' endurance to leave the shed during any temporary lull in the wind, carry out a fortnight's flight, and calculate on being able to return and land during another lull in the ensuing week. Should the large ship meet a storm, she will be able to go round or over it, and could afford to wait in the air for fine weather in which to land. Thus, if the endurance of a rigid is increased to a sufficient extent, it will be possible to carry out flights with a regularity comparable to that maintained by surface craft. The range, practically speaking, is almost unlimited, and the weight carrying capacity large. A 10,000,000 cu. ft. capacity rigid will have a disposable lift of over 200 tons, which is available for gasoline, ballast, crew, passengers, freight, in varying proportions as desirable. The uses to which such an airship could be put are clearly of great importance. Further, there is no other type of vessel which could as efficiently undertake them.

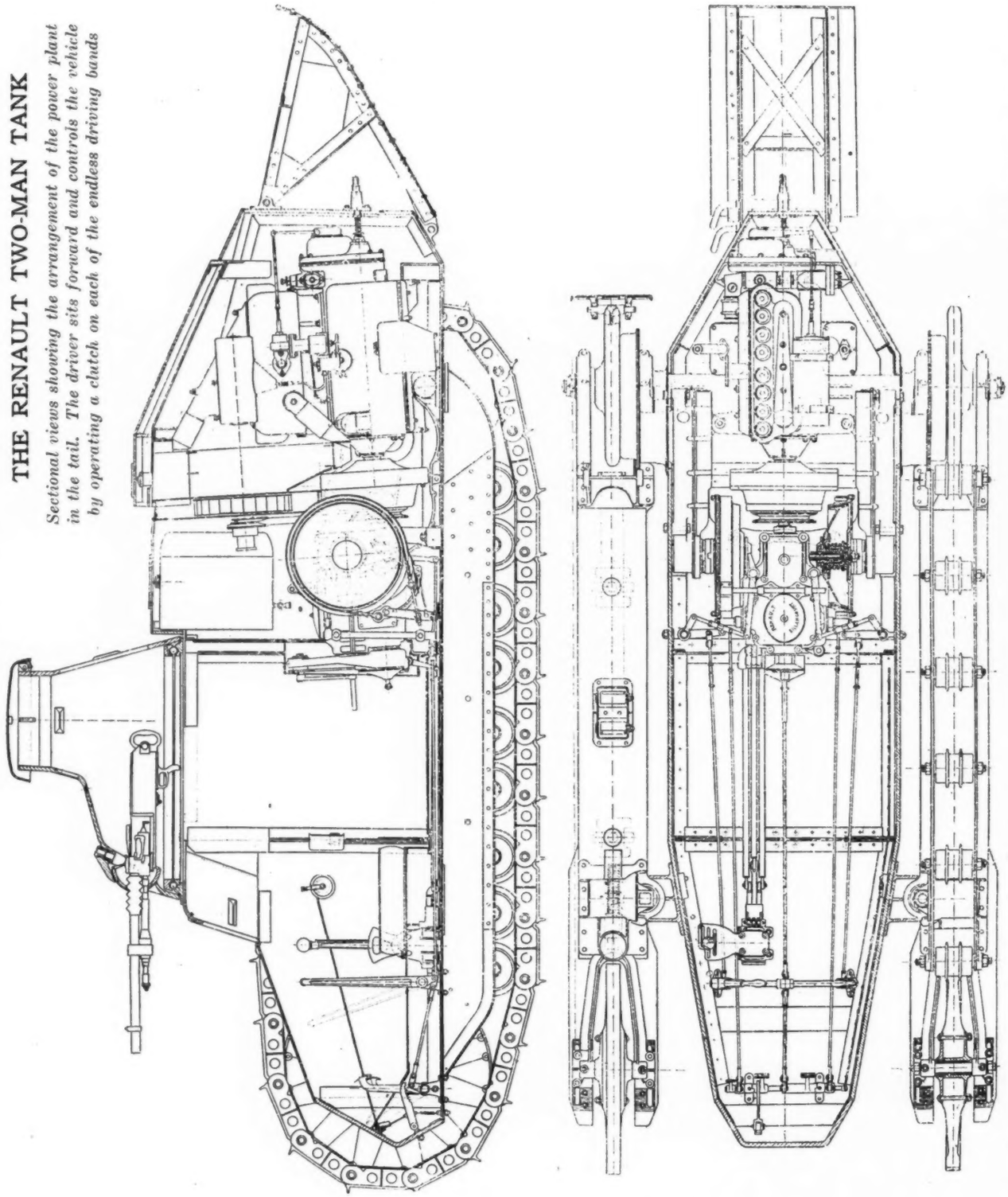
With a rigid of about 10,000,000 cu. ft. capacity, and endurance of approximately 3 weeks at 40 to 45 m.p.h., with a maximum speed of 70 to 80 m.p.h., a ceiling of some 30,000 ft. can be obtained, and a maximum range of over 20,000 miles, or nearly once round the world. This colossal endurance and range of action can be achieved in large rigids because, contrary to H/A, the characteristics of L/A are governed by two factors:

1—The lift of a rigid is proportional to its cubic capacity (dimensions).

2—All fuel carried is used for forward propulsion and not, as in the case of H/A craft, chiefly for maintaining the structure in the air, the head resistance of the airship being small compared to that of an airplane of the same lift

THE RENAULT TWO-MAN TANK

Sectional views showing the arrangement of the power plant in the tail. The driver sits forward and controls the vehicle by operating a clutch on each of the endless driving bands



The French Baby Renault Tank

Weighs 6½ Tons Complete with Machine Gun—Has a Maximum Speed of 4.8 M.P.H.—Can Climb a Gradient of 119 Per Cent—Is Driven by a Small Four-Cylinder Engine and Can Be Handled Efficiently by Two Men

By W. F. Bradley
AUTOMOTIVE INDUSTRIES' *European Correspondent*

Showing the general construction of the Renault tank. The driving sprocket is at the rear, the endless band passes around a pulley at the front, and between these is a series of idlers and automatic tensioning apparatus

IN October, 1917, Louis Renault presented to the French War Department a new type of tank with the remark: "Try it out, and if it meets your requirements I can supply you thousands like it."

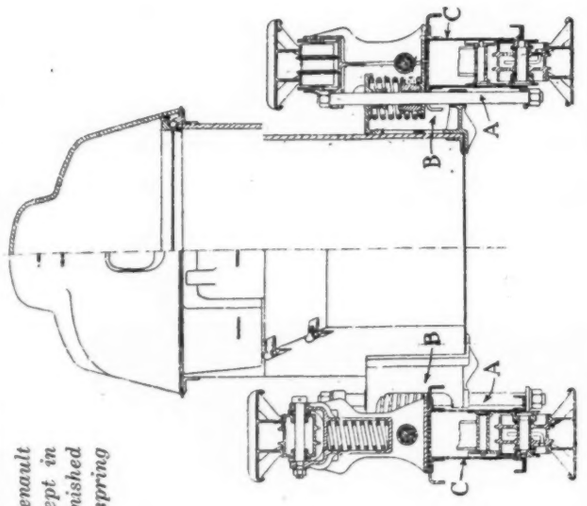
Up to this time France had followed in the wake of England so far as tank construction was concerned. The first British tanks, as is generally known, were huge structures of heavy weight and armament and of very slow speed. The French set to work on the same general lines, but were far from being as successful as their Allies. Not only were the first French tanks inferior in design and construction to the first produced in England, but they no longer possessed the factor of surprise for the enemy. Two or three types were made, both with mechanical and electrical transmission, but without in any case the results being satisfactory. Military men declare that the very best results were obtained when the big French tanks fell into the hands of the Germans, for our enemies immediately set to work to copy them, and in doing so accentuated all the worst defects. As a consequence, the German army has the worst tanks in Europe.

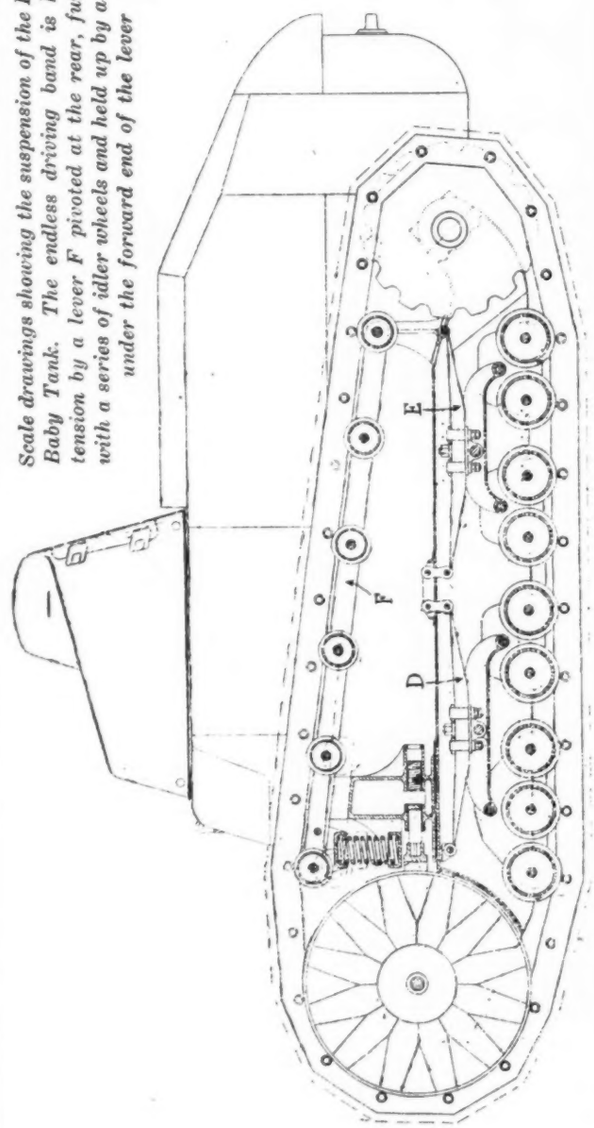
The big tank, weighing 30 tons and more, is slow, and difficult to maneuver. When under observation, its rate of travel being accurately known and its course being comparatively fixed, it becomes an easy target for artillery. Its rate of travel is about two miles an hour; experience has shown that this is too slow. Although popularly supposed to be able to travel anywhere, a big tank can get into positions from which it is impossible to extricate itself, and, the unit being big and important, the loss is considerable.

Acquainted with the general history of tank development, Louis Renault decided to strike out on different lines. He himself laid out the general plans, entrusted the details to his engineers, and had the first tank built entirely in his own automobile factory at Billancourt, near Paris.

Renault's tank weighs 6½ tons completely equipped with machine gun; it has a maximum speed of 4.8 miles an hour; it can climb a gradient of 119 per cent; its motor is a small four-cylinder of only 3.7 by 6.29 in. bore and stroke, and the machine can be handled with extreme ease by two men—one gunner and one driver. Owing to its small weight and area, the transportation of this tank aboard a truck is a very easy matter.

The first tests of this machine were so satisfactory that a big series was ordered at once. Work was carried out actively during the winter of 1917 and the spring of 1918, with the result that they were able to play a very important rôle in holding up the last German attacks in the early summer of 1918 and in carrying through to





Scale drawings showing the suspension of the Renault Baby Tank. The endless driving band is kept in tension by a lever F pivoted at the rear, furnished with a series of idler wheels and held up by a spring under the forward end of the lever

a successful issue the Allied attacks from July, 1918, to the signing of the armistice.

The general lines of these tanks are familiar by reason of the number of illustrations which have been published. The motor is at the rear; it drives through a four-speed and reverse gearset and a series of reduction gears to the large sprocket at the rear of the self-laying track. The driver is at the forward end. Behind him is the gunner, who operates either a machine gun or a cannon mounted in the revolving turret. This design divides the tank into two compartments: a rear one for the motor, transmission, radiator and gasoline tank, and a forward one for the driver and gunner. When in action the driver must remain seated; the gunner has standing room in his turret.

The Renault tank is divisbile into three components: the two side frame members with the main driving sprocket at the rear, the idler pulley at the opposite end, and the rollers and endless track between the two; the steel-plated body of the tank, containing the motor and reducing gears, attached to the side frame.

Details of Endless Tracks

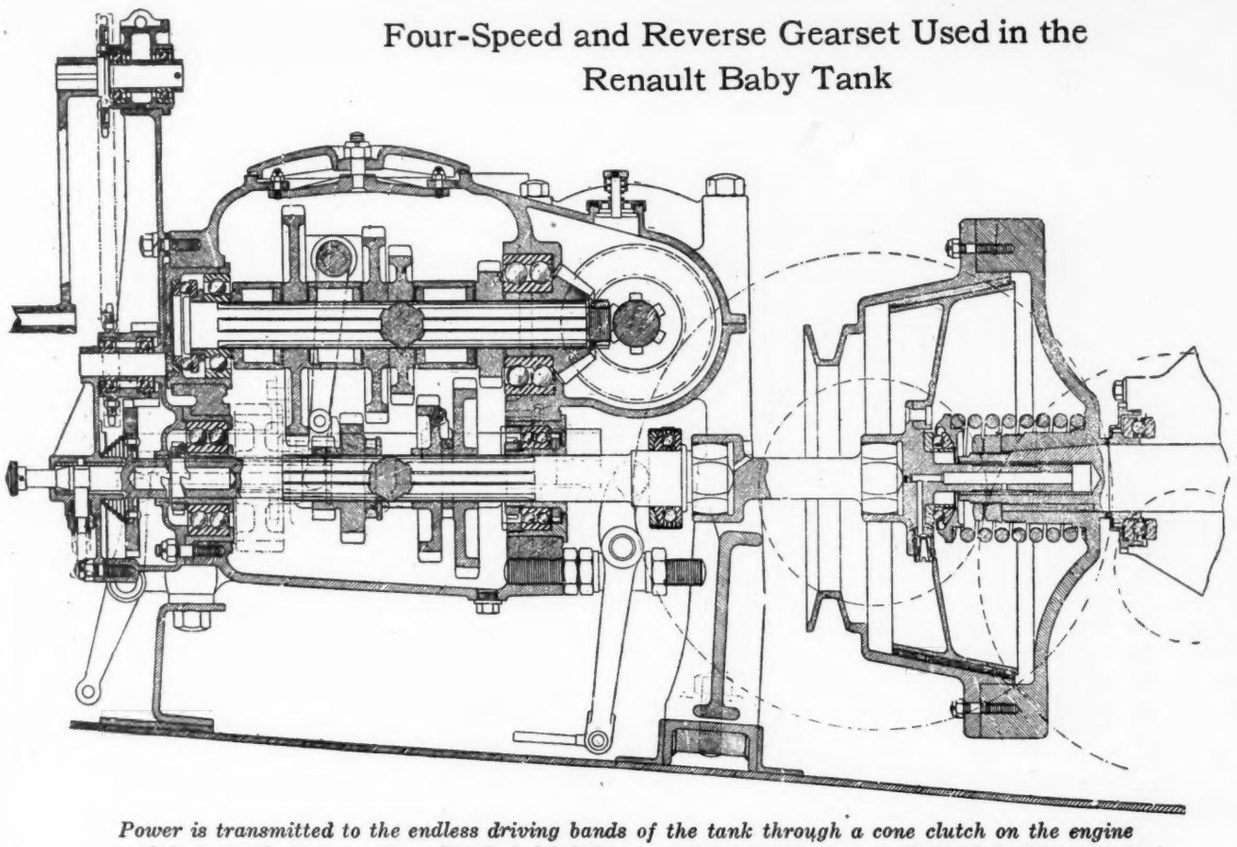
As Renault claims a patent for the construction of his endless tracks, they are worth describing in some detail. The frame members—by this term is understood the whole of the track-laying mechanism—are mobile in relation to the body of the tank, for they are pivoted around the rear axle, and at the forward end they are attached by means of two guiding bars, *A*, Fig. 1, secured to the body of the tank by means of the hangers *B*. Each of the main frame members *C* is carried by means of two laminated Springs *D* and *E* on two balance arms, on the extremities of which are four bogies. The wheels of these bogies run on the endless track.

The main driving sprocket is at the rear. At the opposite extremity is a larger diameter wooden pulley with a steel rim. This is shown in the drawing with spokes, but it is now disk construction. This forward pulley is carried in a fork, and has a lateral movement to allow of adjusting the endless band. In order to support the endless track between the driving sprocket and the jockey pulley there is a bar *F* pivoted at the rear, carried in guides at the front, and maintained in position by a coil spring under its forward end. This bar carries six rollers, and the arrangement gives a constant and automatic tension of the endless track, and at the same time supports it for a length of about 78 in. As the two tracks have a width of 13½ in. and a length of 110 in., the load per square inch is nearly 5 lb.

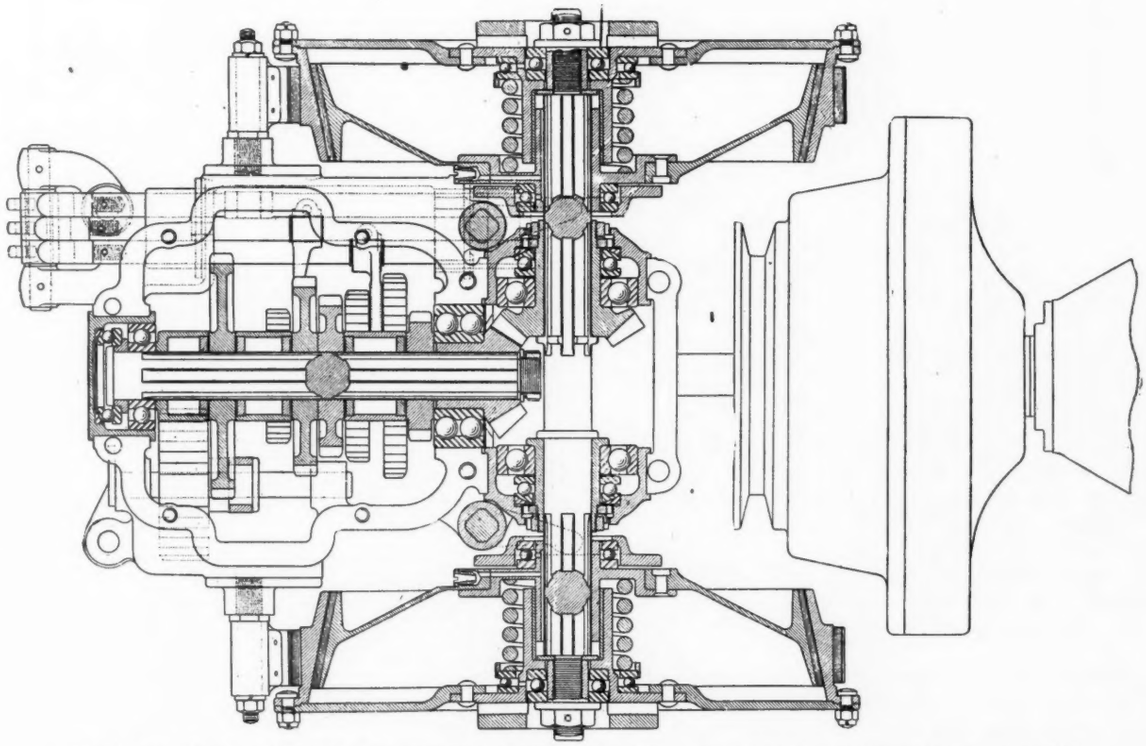
The individual links of the endless track are connected by means of case-hardened bolts having a diameter of 0.9 in. All the rollers have phosphor-bronze bushes. Trouble has been experienced in many makes of tanks with the breakage of the bolts connecting the links of the endless track. It is claimed that, providing the case-hardening is satisfactory, and the tracks are kept under correct tension, there is very little trouble with the Renault in this respect. The bushed rollers, too, have a comparatively long life. It is generally found that the track needs tensioning after 2 hours' hard running. After this it can be run 15 to 20 hours under severe conditions—in heavy mud and in water—before it needs further attention.

The body of the tank is an all-steel construction, varying in thickness from 0.6 to 0.3 in. The maximum thickness is found in the vertical sides; but most of the surface is either inclined or rounded, so that the tendency of a bullet or shell splinter would be to strike obliquely, and this allows thinner armoring to be made use of with security. The turret is mounted on ball bearings,

Four-Speed and Reverse Gearset Used in the Renault Baby Tank

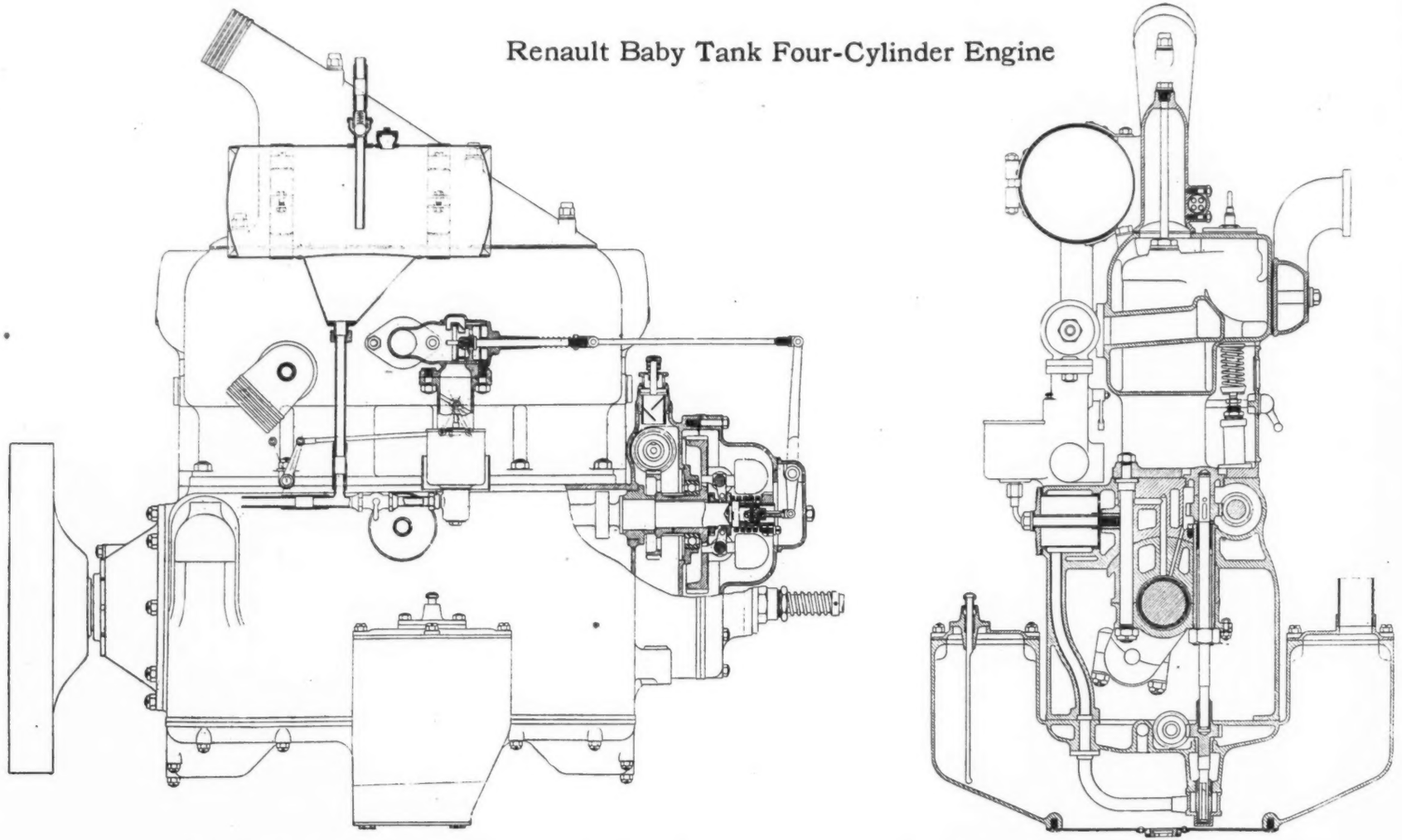


Power is transmitted to the endless driving bands of the tank through a cone clutch on the engine and four-speed gearset. Immediately behind the gearset is a transverse shaft which is driven by a bevel on the end of the intermediate shaft. Note the hand cranking device at the forward end



Horizontal section through the gearset, showing the two cone clutches, independently operated, which transmit the power to the endless driving band. Steering is accomplished by releasing one or other of these two clutches

Renault Baby Tank Four-Cylinder Engine



Part sectional views of the 3.7 in. by 6.9 in. four-cylinder engine used in the Renault two-man tank. The view at the left shows the governor-controlled Zenith carbureter which has an interesting method of feed. Gasoline is supplied under pressure from a main tank and any quantity above that taken by the engine is by-passed up to a reserve tank on the top of the engine, from which it overflows through a ball-check valve back to the main tank. The lubrication of the engine is of the dry sump type, oil being supplied to the bearings under pressure.

and carries in its interior either a machine gun or a cannon.

A four-cylinder engine of only 3.7 by 6.29 in. bore and stroke is much smaller than is popularly imagined to be necessary for a tank. It has been found, however, to be quite sufficient for the work. The actual horsepower developed is 30 at 1100 revolutions, 33 at 1200 revolutions, 35 at 1300 revolutions, and 39 at 1500 revolutions. The torque is 19.7 kilogram-meters at 1200 revolutions.

The lubrication and the gasoline feed systems are the most distinctive features about the motor. Its four cylinders are a block casting, the central bearing is of considerable length, and being a Renault construction the water circulation is by thermo-siphon. The radiator, a plain tubular type similar to those used on Renault trucks, is mounted transversely inside the tank body, ahead of the engine. A centrifugal fan, driven from the main shaft by a motorcycle type rubber belt, draws air in through all the openings in the body and expels it vertically. This not only cools the circulating water, but ventilates the entire tank. While it is admitted that the engine can be kept cooled without a water pump, this feature of the construction has been much criticised by the tank crews, who point out that they are at the mercy of a rubber belt. If this breaks in action the engine is almost certain to overheat and all ventilation is stopped.

Dry Sump Lubrication

Lubrication is of the dry sump type. There are two large capacity pumps, one at each end of the base chamber. These drive all the oil which drips from the bearings into the main oil reservoir, built under and to left and right of the central portion of the base chamber. A pump driven off the camshaft delivers the oil under pressure to the main bearings and to collector rings, which distribute it by centrifugal force to the connecting-rod bearings and to the wrist pins. With this dry sump and central oil reservoir the engine can operate at any inclination.

The motor has a governor operating on the throttle of a Zenith carbureter. The main gasoline supply is carried just ahead of the motor, the fuel being fed from this tank to the carbureter by means of an air pump driven off the camshaft. The excess gasoline not absorbed by the carbureter is carried up a vertical tube, Fig. 3, to a reserve tank immediately above the cylinders, and the overflow from this tank goes to the main tank by means of a standpipe. As the outlet of this pipe is provided with a ball check valve, the gasoline cannot return to the main tank unless a determined pressure has been reached in the reserve tank. This pressure is such that whatever the inclination of the vehicle, gasoline must be carried under pressure to the carbureter. As the reserve tank is airtight, the mass of air above the gasoline forms an elastic regulator of the gasoline pressure in the feed pipes. Also, if the pump ceases to work, the carbureter is fed from the gas carried in this reserve tank. As a precaution against pump failure there is a hand air pump by the side of the driver.

In this picture the tank is practically standing on its tail and consequently is being stabilized thereby

Showing the Renault tail, a feature which was added when its possibilities became apparent

Steering Through Clutches

Power is transmitted from the motor through an inverted leather-faced cone clutch to a four-speed and reverse gearbox, Fig. 6. The intermediate shaft of this gearbox carries a bevel pinion at its rear end, engaging with a crown wheel on the transverse shaft. Fig. 7 shows how the power is transmitted from the gearset through two large diameter cone clutches lined with Ferodo to the reducing gear (not shown in this drawing). These lateral clutches can be operated independently, and by throwing out either one or the other both the reducing gear and the endless band on that side are stopped. Each set of reducing gears is contained in an aluminum housing mounted by the side of the motor, and consists of the first driven pinion, two intermediaries, and the final driven pinion carrying the endless band. Connection from the clutch shaft to the first pinion of the reduction gears is by means of an Oldham coupling, not shown in Fig. 7. The two sets of reduction gears are in dustproof and oil tight casings, and the whole construction is remarkably compact, the space occupied being very much less than the motor and gearset of a 3-ton truck.

The total gear ratios are 114.5 on first and reverse, 56.3 on second, 34.5 on third, and 22.3 on fourth gear. The reducing gears between the lateral clutches and the main driving pinion carrying the endless band have the following ratios: 58:12, 30:16 and 38:13. The drawbar pull is 11.090 lb. on first and reverse and 992 lb. on fourth speed.

The total length of the Renault tank, without tail, is 161 in.; total width is 66 in.; track, measuring from center to center of the bands, is 55 in.; distance between the two main wheel centers (main driving pinion and main pulley) is 110 in.; the width of the endless bands is 13½ in., and the total height of the machine is 84 in. The weight is 6½ tons with machine gun.

Front view of the tank with all doors open. The driver is grasping the right-hand clutch lever

The driving of these tanks is a remarkably simple operation. The driver sits on a cushion on the floor, with his back supported by a transverse girth. He has the same pedal controls as on a standard automobile: clutch, brake and accelerator. To his right is a selective change-speed lever, giving four combinations ahead and one reverse. There is no steering wheel. In its place are left and right-hand levers. By pulling out the left-hand lever the left-hand lateral clutch is withdrawn and the left-hand track is stopped. To make a quick turn the left-hand clutch lever is pulled further to the rear, when it applies a band brake on the left-hand clutch drum, thus locking the left-hand track and causing the whole machine to pivot around. To turn to the right the same movements are made with the right-hand lever.

A mobile tail is bolted to the rear of the tank. The object of this is to facilitate the passage through holes and trenches. When a tank is obliged to crawl down into a trench the tail finds a support against the bank, thus decreasing the inclination of the machine and giving a support for climbing up the opposite bank. Briefly, it has the same functions as the crocodile's tail.

The military organization of the tanks is in companies of twenty, one of which is the commanding officer's tank, provided with wireless, and in consequence not carrying cannon or machine gun. When going into action the commanding officer keeps in communication with headquarters by means of his wireless and communicates orders to the men of his company by means of signals. As the chief work of the tanks is to destroy machine-gun nests, about half the machines in each company are fitted with a machine gun and half with a cannon. Each company has attached to it a mechanical staff of one non-commissioned officer and half a dozen mechanics, who are provided with a truck and hand tools, and are capable of carrying out all slight repairs.

The moderate weight of these tanks and their comparatively small dimensions make their rapid transportation to different portions of the battle front a very easy matter. A loading platform can be built by a gang of men in two or three hours. Gasoline or steam trucks with flat bodies can be backed up to this platform, and the tanks run aboard under their own power. With a single platform a company of twenty tanks can be loaded in an hour, and when loaded can be moved away at an average speed of 10 miles an hour. Thus, between sunset and sunrise a fleet of Renault tanks can be moved a distance of about 80 miles, and immediately on being unloaded they are ready to proceed to the fighting line and go into action. Or the tanks can be grouped 60 miles in the rear of the battle line, where they are completely hidden from enemy observation, and the following morning they can get into action to the complete surprise of the enemy. This extreme mobility is one of the most valuable features of the Renault type tank compared with the big machines, which must necessarily, on account of their weight, always proceed under their own power, at a road speed of only 2 or 3 miles an hour.

Driving Is Simple

There has never been any difficulty in training all the men that were required for handling the Renault tanks. Recruits are asked for, and usually young men are selected, but it is not considered necessary that they shall have had previous automobile experience. They are first of all taught to drive a touring car, then are given some practical instruction in general motor mechanics. After this they go right into the tank school. The control of the Renault tank is so simple that any person who can drive an automobile is capable of taking one across country after a few minutes preliminary instruction. Skill and judgment have to be acquired in the manner of tackling different kinds of trenches and shell holes, but this is not a long process.

There is no doubt that Louis Renault was on the right line of thought when he decided on the reduction in size and weight of tanks and the limiting of the crew to two

(*Continued on page* 506)

A squadron of Renaults proceeding through difficult, wooded country. The machine in the foreground is that of the commanding officer and is equipped with wireless

Small Inlet Valves Satisfactory in Overhead Valve Design

Improvement in Fuel Consumption with Increase of Speed Is Clear and Unmistakable—Thermal Efficiency Independent of Load and R.P.M.

PART II

THE advantage of 16 per cent higher brake mean effective pressure in the valve-in-head design than in the L-head design is due to the shape of the combustion chamber.

Mr. Pomeroy said: Fig. 7 is a diagram showing the following relationships:

1. The average brake mean effective pressure at various revolution speeds for the tests in which the inlet gas velocity was under 300 feet per second.
2. The compression pressures (gage) corresponding to the above. Table VI. shows the tabular values corresponding to Fig. 7.

TABLE VI.

Revs. per minute	A — n_p, lb. per sq. in.	A — Compression pressure, lb. per sq. in.	B — n_p, lb. per sq. in.	B — Compression pressure, lb. per sq. in.
800	80	91	83	94
1,200	83	94	94	101
1,600	83	99	96	104
2,000	81	101	94	103
2,400	78	98	91	99

The general characteristics of the curves are:

1. A rapid rise up to speeds of 1,000 to 1,200 revs. per minute.
2. A slow rise to a maximum of about 1,600 revs. per minute.
3. A gradual fall as the speeds increased to 2,400 revs. per minute.

The rapid rise in brake mean effective pressure in engine B is probably due to the fact that the engine is fitted with a light flywheel and presents greater difficulties in taking slow speed tests. In both engines it was very difficult to get accurate readings at speeds of 800 revs. per minute or under.

It will be seen that the compression curve of engine A rises more rapidly than that of engine B, and approximates to the latter at speeds over 1,800 revs. per minute.

Further, the brake mean effective pressure in engine A is appreciably more independent of the compression pressure at the various engine speeds than in engine B.

The most significant point, however, is the very distinct difference between the average brake mean effective pressures obtained in the two engines, approximately 13 lb. per sq. in.

The author is somewhat at a loss to account for this in view of the almost identical construction of the engines. The detailed figures which have been given in Tables I and II seem to exclude any simple explanation which might be suggested on the grounds of varying compression pressure, carburetion, etc.

Many subsidiary tests were made to throw some light on this question, among them the fitting of light aluminum pistons to engine A, the fitting of different carbureters, alterations of valve settings, in fact, the whole resources of the tuner-up were invoked with no result; engine A seemed completely indifferent to all such treatment.

From these experiments the author considers that the cause of the difference in brake mean effective pressure, which gives engine B an advantage of some 16 per cent over engine A, can only be sought in the feature in which the engines differ most, *i. e.*, the combustion chamber.

The combustion chamber of engine A was of the orthodox side-by-side valve design, the two valves being in a pocket projecting laterally from the cylinder barrel and being formed in part by the valve caps screwed in from the top of the cylinder. In the case of engine B the combustion chamber was also pocketed laterally, the two exhaust valves being in one pocket and the inlet partly in another, partly

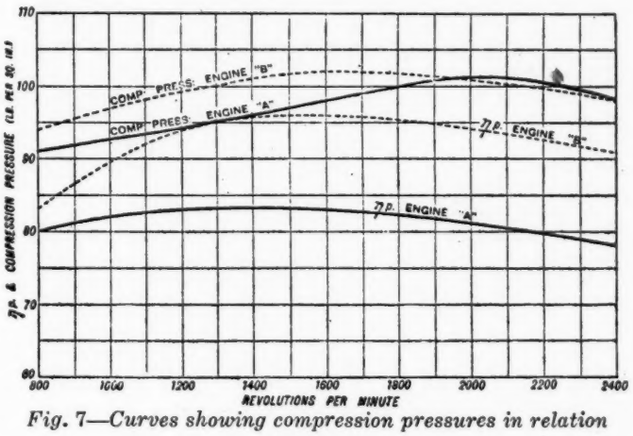


Fig. 7—Curves showing compression pressures in relation to r.p.m.

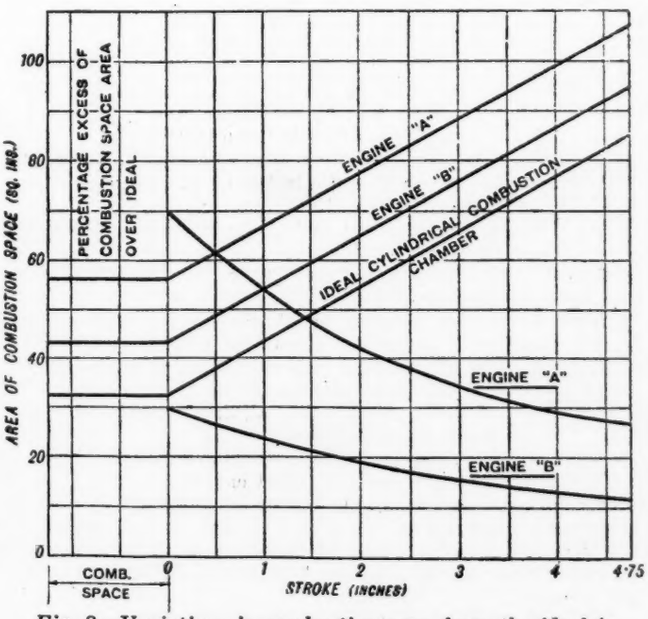


Fig. 8—Variations in combustion area from the ideal in engines A and B, expressed as percentages

discharging direct into the cylinder barrel. The valves were inserted from inside the cylinder.

The ratio of surface of combustion chamber to volume is as follows:

Engine A	4.66:1
Engine B	3.6:1
Ideal cylindrical type	2.75:1

The proportions of water jacketed to unjacketed surface in each case are approximately as follows:

	Water jacketed	Unjacketed
Engine A	30.4 sq. in.	25.6 sq. in.
Engine B	24.8 sq. in.	18.2 sq. in.
Ideal cylindrical type	18.3 sq. in.	14.7 sq. in.

Fig. 8 is a diagram showing the area exposed to cooling at each point of the stroke. From this it will be seen that the area of the combustion chamber in engine B is about midway between that of engine A and that of the quasi-ideal cylindrical type. Expressed as percentages, the excess of the surface over the ideal in engines A and B is given in the curves in Fig. 8. At the top dead center the excess of combustion chamber area over that of the ideal cylindrical type is 70 per cent in the case of engine A and 30 per cent in the case of engine B. At the bottom dead center the figures are 27 per cent and 12 per cent respectively. These figures are striking and suggest that in the ratio of surface to volume of the combustion chamber may be the reason for the increased brake mean effective pressure found in engine B.

If such is the case it is of interest to compare the performance of engines A and B with that of an "ideal" engine of the same proportions.

Following Mr. Ricardo's analysis of the various factors concerning engine performance given in Mr. Berriman's paper before the Institution last month, it will be found that for a compression ratio of 4.8:1 the ideal indicated mean effective pressure is 134 lb. per sq. in.

In these engines, however, the inlet valve does not close till a crank angle 45 per cent past the bottom center, corresponding to an upward piston movement of 0.4 in. This is equivalent to shortening the compression stroke and alters the compression ratio accordingly, which now becomes

$$\frac{4.8 \times 4.35}{4.75} = 4.4{:}1.$$

Checking this against the actual compression pressure, say 100 lb. per sq. in., and assuming that the pressure in the cylinder at the moment of closing the inlet valve is 14.7 lb. per sq. in.:

$$P_1V_1^n = P.V.^n$$
$$\frac{114.7}{14.7} = 4.4^n$$
$$7.8 = 4.4^n$$

or $n = 1.37$, a value for n which is not unreasonable.

The indicated mean effective pressure corresponding to this corrected compression ratio is 128 lb. per sq. in.

Fig. 9 and Table VII show the following:

Curve 1. Revolution speed and brake mean effective pressure engine A.

Curve 2. Revolution speed and brake mean effective pressure engine B.

Curve 3. Revolution speed and brake mean effective pressure ideal engine (calculated).

Curve 4. Revolution speed and calculated indicated mean effective pressure engine A.

Curve 5. Revolution speed and calculated indicated mean effective pressure engine B.

Curve 6. Revolution speed and calculated indicated mean effective pressure ideal engine.

The calculated figures in the above are obtained by taking the figures given above, and adding to these a mean pressure for the suction exhaust loop of the diagram of 2 lb. per sq. in. at 800 revs. per minute, and 5 lb. per sq. in. at 2,400 revs. per minute.

The indicated mean effective pressures are seen to be remarkably constant with respect to revolution speed, but the

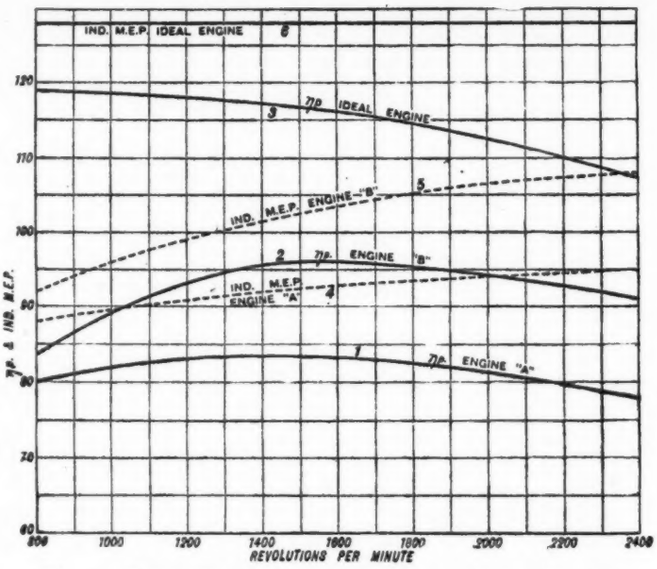


Fig. 9—Mean effective pressure of the engines under test at various speeds

difference between engines A and B, of course, remains. Comparing the average mean effective pressures in Table VII, the ideal engine gives 128 lb. per sq. in., engine A 93 lb. per sq. in., engine B 104 lb. per sq. in.

The chief advantage which might be expected in respect of the more compact combustion chamber in engine B is that the jacket loss during explosion and expansion would be less, and that part of this gain would be reflected in an increased mean effective pressure. The fuel consumption results, however, do not support this view. Table VIII gives the calculated indicated fuel consumptions, and shows that although the thermal efficiency increases with the speed, the actual consumptions are substantially the same in each engine at any given speed.

The greater mean effective pressure in engine B compared to engine A is not therefore susceptible of explanation on the grounds of greater thermal efficiency. It is of interest, however, to consider briefly the relationship between jacket loss and thermal efficiency.

The fuel supplied to an internal combustion engine can be accounted for mainly under the following heads:

1. Indicated work.
2. Heat lost to jacket.
3. Heat lost to exhaust.
4. Heat lost due to imperfect combustion.

No measurements of items 2 and 3 separately have, to the author's knowledge, been made on small gasoline engines, the usual measurements in engine tests being that of heat rejected to cooling water, which includes a large part of that which should properly be credited to the exhaust.

TABLE VII.

Lb. Per Sq. In.

Revs. per minute	Ideal Engine Ind. M.E.P.	Ideal Engine np	Engine A Ind. M.E.P.	Engine A np	Engine B Ind. M.E.P.	Engine B np
1,200	128	118	91	83	101	95
1,600	128	116	93	83	105	96
2,000	128	113	94	81	106	96
2,400	128	109	93	78	104	91

TABLE VIII.

Calculated indicated consumption. Pts. per B.H.P. per hour.

Revs. per minute	Ideal Engine	Engine A	Engine B
1,200	0.49	0.81	0.81
1,600	0.49	0.72	0.69
2,000	0.49	0.62	0.62
2,400	0.49	0.62	0.63

The subject of the proper division of the various losses has, however, been investigated in connection with slow speed gas engines by Clerk and Gibson and Walker experimentally, and by Lanchester before this Institution.

In the latter paper Lanchester shows that the heat lost to the jacket can be approximately expressed as being in part a constant loss fixed by the size of the engine, and the remainder as a constant percentage of the total fuel heat, due mainly to internal radiation, which can be expressed as a percentage of the horsepower.

Both experiment and calculation show that for an engine with an ideal cylindrical combustion chamber the jacket loss is a smaller proportion of the total heat supplied at high speeds than at low speeds. The difference, however, at full load is not great. For speeds of 100 revs. per minute to 250 revs. per minute Messrs. Gibson and Walker found the jacket loss varied from 20 per cent to 16 per cent of the total heat.

The effect of this reduction of jacket loss upon thermal efficiency is very small. In Messrs. Gibson and Walker's experiments the increase in indicated thermal efficiency for an increase in speed at full load from 100 revs. per minute to 250 revs. per minute was about 1 per cent. The reduced jacket loss was accompanied by an increased loss to exhaust of almost the same amount.

The reason for this is that a large part of the jacket loss occurs after expansion, and obviously cannot affect thermal efficiency.

Messrs. Gibson and Walker's experiments were carried out upon a gas engine, and it is known that combustion was practically complete.

In the engines under discussion there is reason to doubt if combustion is complete, owing to the extended nature of the combustion chambers and the fact that a considerable fraction of the charge may have been rendered non-effective due to being in contact with a comparatively cold surface.

Deficiency from the Ideal

The surface of the combustion chamber in engine A is, as has been said, 56 sq. in.; that in engine B 43 sq. in. The compression volume is 12 cu. in. A non-effective layer of gas 1/16 in. thick in each combustion chamber would entail a loss of 29 per cent of the fuel supplied to engine A, and 23 per cent in the case of engine B, with corresponding reduction in the mean effective pressure compared to the ideal. The actual deficiency compared to the ideal is 27 per cent in engine A, and 18 per cent for engine B.

The high fuel consumption in both engines on full load at low speeds also suggests incomplete combustion. The mixture supplied was of such richness as to be scarcely combustible if homogeneous, yet no extra air could be supplied to the engines in the low speed tests. With increase of speed combustion apparently becomes more complete with consequent reduction of the fuel wasted per stroke.

Another characteristic of an extended combustion chamber is that of the relatively sluggish ignition which takes place therein. In the tests under discussion engine B was more sensitive to the position of the spark than engine A.

The author is conscious of the vagueness of this attempt to explain the difference in the mean effective pressures of engines A and B as compared with each other and also in terms of increase of engine speed. The phenomenon of combustion in such small combustion chambers is undoubtedly very complex, and there is ample scope for experiment to determine the extent to which heat loss and mean effective pressure are affected by combustion chamber shape and revolution speed, and the true explanation thereof. The general conclusion in respect of the influence of revolution speed upon brake mean effective pressure is that the rise in brake mean effective pressures at the lower speeds is due to the diminishing effects of incomplete combustion, while at the higher speeds these influences are more than negatived by the decrease in mechanical efficiency, thus causing the characteristic slow fall in the brake mean effective pressure—revolution per minute curve.

A—Full Load

Deduction.—Whatever the cause, the evidence as to improvement in fuel consumption with increase of speed is clear and unmistakable.

Mr. Pomeroy analyzed the performances as follows:

In both engines A and B the fuel consumption at 800 revs. per minute is about one pint per brake horsepower per hour, and falls to about 0.72 pints per brake horsepower per hour at 2400 revs. per minute. As mentioned in the previous section, no great improvement would be expected due to reduction in jacket loss with an engine in which the combustion chamber was of compact form. On the other hand, there is ample evidence that combustion is more complete with increase of engine speed. The fact that the fuel consumptions in the two engines are so nearly the same, while the combustion chamber proportions are so different, calls for some explanation. The author suggests that this is due to delayed combustion of what may be called the surplus fuel supplied. If this is being burnt more or less non-effectively during the latter part of the expansion stroke, and quite non-effectively during the exhaust stroke, the *excess* of combustion chamber surface in engine A over that of engine B must be considered as a fraction of the total surface exposed during the process of delayed combustion, in which case it becomes so small as to be negligible. Whatever the cause the evidence as to improvement in fuel consumption with increase of speed is clear and unmistakable.

B—Varying Loads

The average consumptions of engines A and B at varying loads are given in Table IX:

Engine A			Engine B		
Pts. per B.H.P. per Hour			Pts. per B.H.P. per Hour		
Revs. per Minute	Consumption	Load	Revs. per Minute	Consumption	Load
2,400	0.73		2,400	0.72	
2,000	0.74		2,000	0.71	
1,600	0.79	Full	1,600	0.76	Full
1,200	0.87		1,200	0.88	
800	0.99		800	1.12	
2,400	0.71		2,400	0.74	
2,000	0.73		2,000	0.71	
1,600	0.77	0.8 full load	1,600	0.73	0.8 full load
1,200	0.84		1,200	0.78	
800	0.98		800	0.86	
2,400	0.82		2,400	0.81	
2,000	0.84		2,000	0.77	
1,600	0.88	0.6 full load	1,600	0.81	0.6 full load
1,200	0.97		1,200	0.87	
800	1.15		800	0.97	
2,400	0.98		2,400	1.0	
2,000	1.05		2,000	1.0	
1,600	1.12	0.4 full load	1,600	1.04	0.4 full load
1,200	1.24		1,200	1.06	
800	1.38		800	1.19	

An inspection of this table reveals the fact that on the whole in both engines the best fuel consumptions occur at 0.8 full load.

The effect of increased speed from 800 revs. per minute to 2400 revs. per minute may be expressed as follows:

Improvement in Consumption with Increase of Speed from 800 *revs. per minute to* 2400 *revs. per minute*

	Engine A	Engine B
Full load	26 per cent	35 per cent
0.8 Full load	27 per cent	11 per cent
0.6 Full load	28 per cent	16 per cent
0.4 Full load	29 per cent	16 per cent

The figures are not conclusive, but they indicate that broadly the improvement in consumption with increase of speed is of the same order at part load as at full load.

The average consumption throughout the speed range of 800 revs. per minute to 2400 revs. per minute is given in Table X for the various fractions of full load.

Table X

Average Consumption
Pints per Brake Horsepower per Hour
800 *revs. per minute to* 2400 *revs. per minute*

	Engine A	Engine B
Full load	0.83	0.71
0.8 Full load	0.83	0.78
0.6 Full load	0.95	0.86
0.4 Full load	1.18	1.05

From this it is seen that the effect of increasing the load from 0.4 to full load, *i. e.*, 150 per cent, is to cause an improvement in consumption of 29.6 per cent in engine A, and of 32 per cent in engine B.

The conclusion from the above is that on the one hand an increase of speed of 100 per cent improves consumption in the order of 25 per cent irrespective of load, and on the other that an increase of load of 150 per cent irrespective of speed causes an improvement in consumption in one engine of 29.6 per cent, and in the other of 32 per cent.

Fuel Consumption Per Hour for Any Given Horsepower

Deduction.—For small gasoline engines working between 25 and 50 per cent of their maximum brake horsepower, the brake thermal efficiency for any given horsepower is independent of the load and revolutions per minute of engine.

Mr. Pomeroy completed his analysis as follows:

The conclusion of the last section leads directly to the main point of practical interest in the paper: In automobile design, the conflicting interests of fuel consumption and engine speed which are usually supposed to lead in general to the use of the highest top speed gear ratio consistent with preserving enough excess torque to enable the vehicle to climb hills without gear change to an extent sufficient to placate the user.

The use of a low top speed gear ratio is commonly understood to carry with it the penalty of excessive consumption.

In the last section it has been shown that both increase of load and increase of speed carry with them reduction of consumption to somewhat the same extent, *i. e.*, 100 per cent increase of load reduces consumption in the same order as 100 per cent increase of speed.

The chief function of an automobile engine is the performance of a given task. In order to propel it at, say, thirty miles per hour on the level a given horsepower is required. Further, this horsepower is only a small fraction of that capable of being developed. In the case of a medium-sized touring car the horsepower exerted at thirty miles per hour is only about 25 per cent to 40 per cent of the maximum it is capable of developing according to the size of the engine and the top speed gear ratio or engine speed.

Selection of Gear Ratio

In selecting the gear ratio for a given engine the designer has obviously a wide range of choice for the development of such a small fraction of the total power available. He can, for example, with an engine such as those under discussion obtain the requisite horsepower at, say, 500 to 600 revs. per minute at full load, or at 2000 revs. per minute at, say, quarter load. In the first case there is no reserve for hill climbing; in the second, the engine revolutions would be a very long way above those appropriate to maximum horsepower before the car was traveling at the speed of which it would otherwise be capable. It is obvious that between these extremes lies the most suitable gear ratio.

If fuel consumption is regarded as being to any extent inversely proportional to engine speed it is necessary to keep the gear ratio as high as possible. On the other hand, if this consideration can be neglected the gear ratio can be chosen so that the engine speed at the maximum car speed on the level corresponds to that of maximum brake horsepower. It can, in fact, go well over this owing to the usual flat top of the curve relating brake horsepower and engine speed.

Consideration of Fuel Consumption

The question is, can considerations of fuel consumption be neglected? The author considers that this can be answered in the affirmative over a large range of engine speed and load.

Horsepower depends upon the product of torque and speed. If consumption varies inversely to the same extent for the same percentage variation of torque and speed, it is obviously a matter of indifference whether a high or low gear ratio is used so far as consumption is concerned.

In the last section some figures relating to the change in consumption with load and speed were given which support this view. Figs. 10 and 11 show the fuel consumption per hour, brake horsepower, and revolutions per minute plotted on three planes of projection for each engine.

Taking the consumption per hour for 10 hp. between speeds of 1200 revs. per minute and 1800 revs. per minute, the increase in consumption is from 11.5 to 12 pints per hour. It follows, therefore, that for an additional consumption of one pint per hour the designer can produce a car with a reserve torque capacity greatly in excess of that usually given.

To confirm the above the author has carried out road tests on his own car fitted with engine A, the car being driven as nearly as possible at a constant speed of 20 miles per hour and 30 miles per hour on top and third speeds respectively.

The results are as follows:

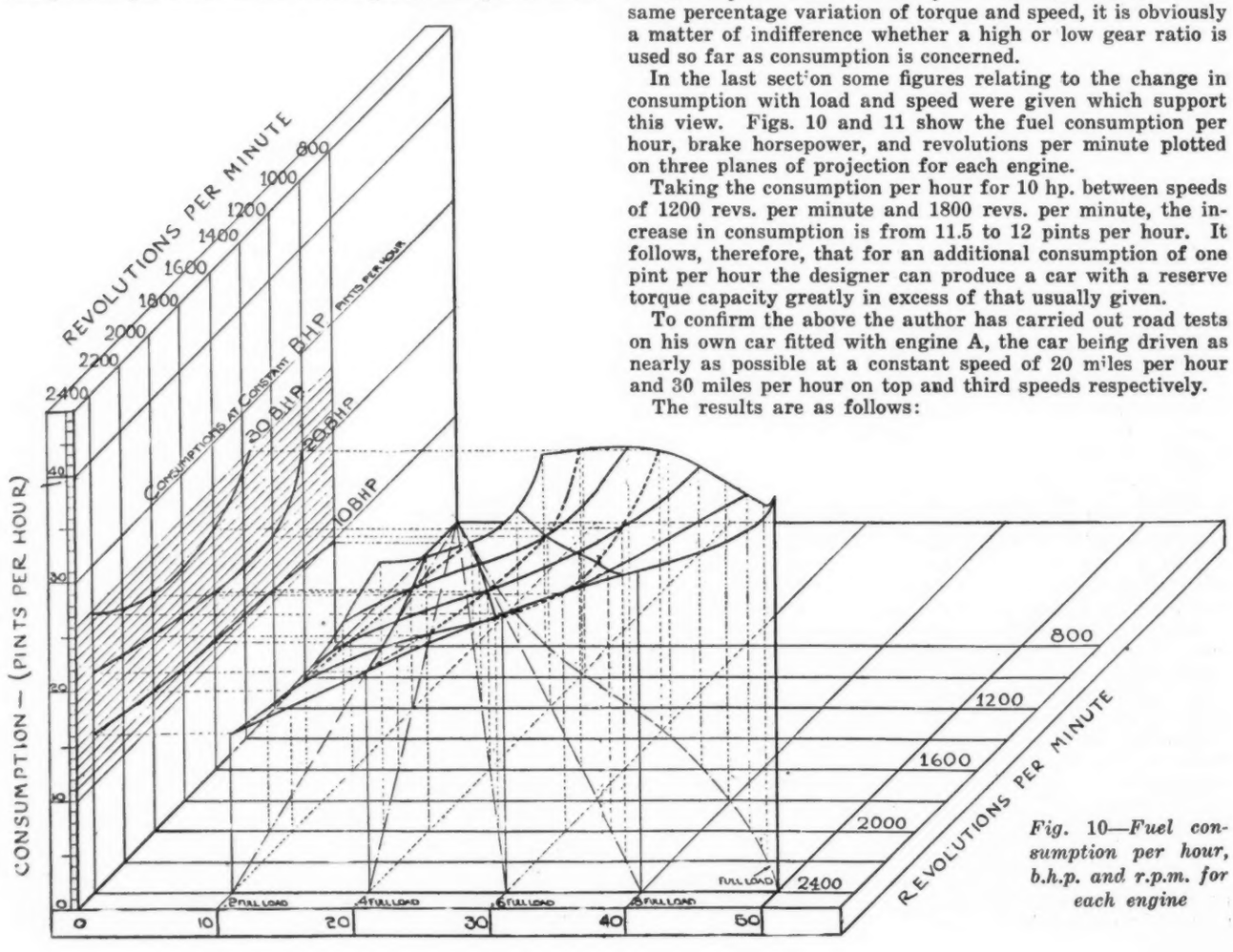


Fig. 10—Fuel consumption per hour, b.h.p. and r.p.m. for each engine

Top speed	Engine revs. per minute	Miles per gallon	
20 m.p.h.	860	24.7	
30 m.p.h.	1,290	23.0	
Third speed			
20 m.p.h.	1,320	21.8	(24)
30 m.p.h.	1,970	19	(21)

In parentheses alongside the actual road consumption is given the consumption allowing for a loss of 10 per cent due to oil churning, gear friction, etc., when running on third speed.

The horsepower necessary to overcome the tractive resistance at 20 miles per hour is about seven, and at 30 miles per hour about twelve. The maximum brake horsepower developed at corresponding engine speeds is about 16 and 25 respectively on top speed. The maximum brake horsepower developed at the same road speeds but at engine speeds corresponding to third speed gear is about 27 and 39 respectively. The power exerted by the engine in these tests therefore varies from about 25 per cent to 50 per cent of full load.

In short, for small gasoline engines working between 25 per cent and 50 per cent of their maximum brake horsepower, the brake thermal efficiency for any given horsepower is independent of the load and revolution speed.

Deductions and Lessons

In conclusion, the author is aware that a series of tests extending over many months such as those described are susceptible of criticism on the grounds of doubt as to their strictly scientific accuracy in view of the infinite number of varying conditions entailed. In spite of this the author feels that the experimental data are substantially accurate. Constant experience with one or two engines produces a very accurate sense of any departure from the normal, and causes the repetition of any tests which seem to be unreasonable.

The principal lessons from the work done are in the opinion of the author the evidence of the high charging capacity of a small overhead inlet valve and the comparative independence of consumption in respect of engine speed and torque for horsepowers up to 50 or 60 per cent of the maximum.

There are many designers now engaged upon the design of overhead valve engines for touring cars inspired by either aero engine practice or the fashion in America, as the case may be. The author would remark that the development of overhead valve engines is being caused not so much on technical or scientific grounds as by the fact that with the ordinary type of engine the fitting of a dynamo and self-starter both carried on the engine is well-nigh impossible.

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Utility of Industrial Laboratories

AMONG the reasons for the success of German industries in the period preceding the war must be reckoned the recognition of the importance of the union of science and practical work, demonstrated by the value ascribed in Germany to industrial laboratories, says a writer in *Le Genie Civil* for Oct. 18. The results, however, obtained up to the present in France have been disappointing when viewed from the financial standpoint, and the author fears that laboratories founded for the purposes of the war will be abandoned as soon as peace is declared.

After laying stress upon the distinction between a laboratory for merely testing the qualities of the product of a given factory and a laboratory for research work proper, he remarks that the manufacturer will rarely hesitate about a reasonable expenditure on the former, but is difficult to convince about the value of the latter. He considers that there is too much individualism among French manufacturers and too little recognition of the work of their subordinates, and he pleads finally for a wider extension of the research laboratory.

—

British Want Ministry of Ways and Communications

IN England there is a movement on foot at the present time looking toward the establishment of a separate Ministry of Ways and Communications. The Commercial Motor Users' Association, which corresponds to our Motor Truck Club, has placed itself on record as favoring the proposition by adopting the following resolution:

"The National Council of the Commercial Motor Users' Association (Incorporated), having considered the proposal to place the control of (a) roads and road transport, and (b) railways under the same ministry, is of opinion, the interests concerned being seldom identical and sometimes conflicting, that housing and other national reconstruction programs, and development of industrial and agricultural road transportation, are likely to be retarded unless such control be entrusted to distinct and separate ministries, or guarantees of like effectiveness be provided by the government in any new departmental organization."

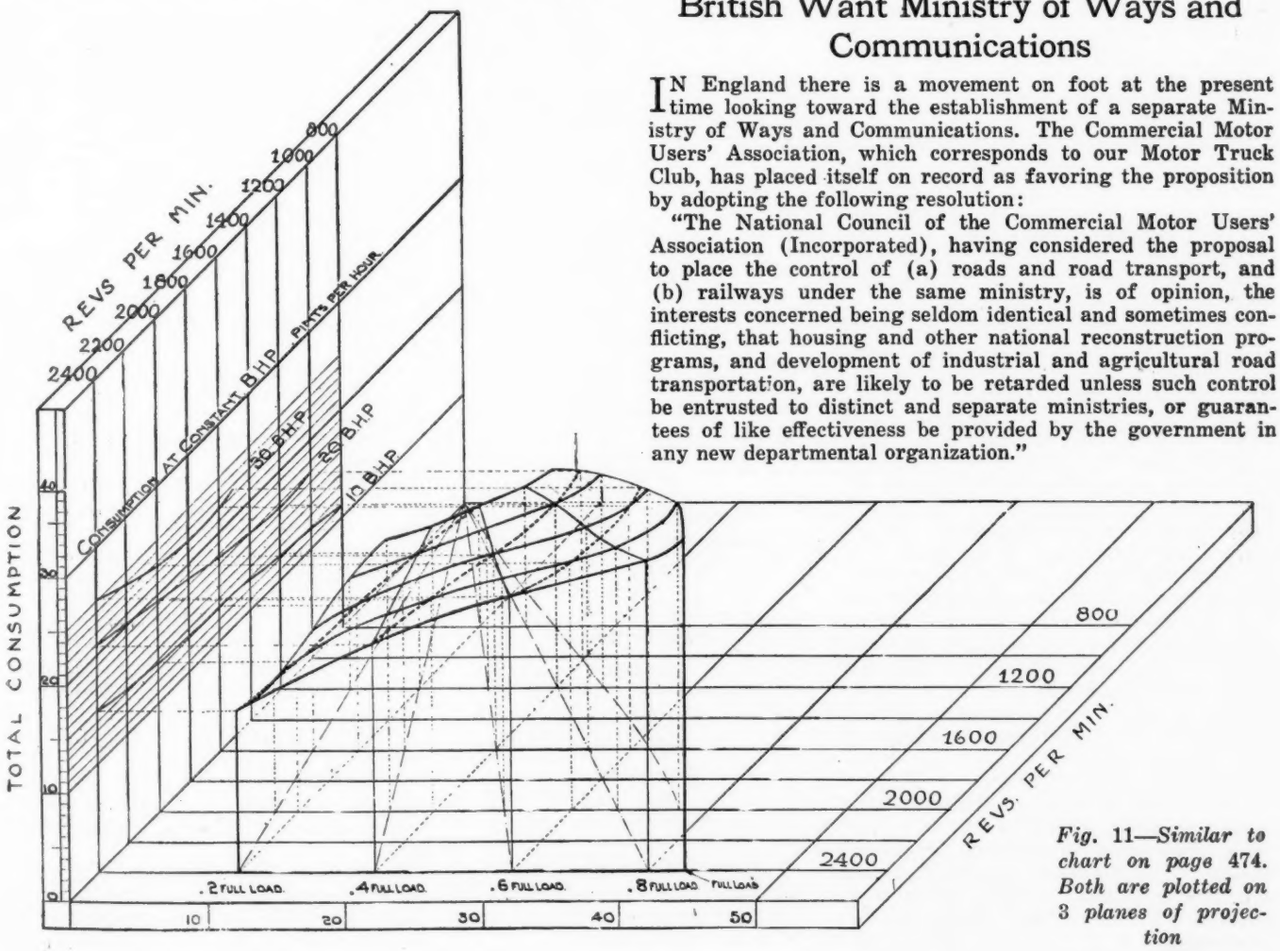


Fig. 11—Similar to chart on page 474. Both are plotted on 3 planes of projection

Labor's Representation in Plant Management the Immediate Problem

Workers' Demand for Voice in Factory Conditions Growing—Elective Representation Successful

By Harry Tipper

IT is evident from the discussions which are occurring in the various engineering and scientific associations and in the organizations of a less specialized character that the labor problem is receiving more study at the hands of the various industries than it has received at any other time. It is also evident from the tenor of these discussions that the futility of any attempts to solve the labor problem which do not take into account the lack of responsibility of the worker to his organization is becoming recognized more and more. The remarks which were contributed by Mr. Corless at the discussion of the Institute of Mining Engineers are indicative of this attitude:

"They have very little or no voice in governing themselves. They are parts of an organization, cogs in an economic machine which they do not fully understand, and in which they almost lose their identity—that is, their freedom for self-development. Somebody, somewhere, shapes the organization and sets it in motion, but the parts of the organization they see or the work they perform usually have little, if any, scientific or social meaning to them. Hence their spirit rebels. The human spirit, unless it has been utterly suppressed, is fortunately so constituted that it always rebels against any form of external authority in which it has no share, and which it does not intelligently grasp.

"Industrial peace will never be attained as long as capital and management assume the right to a final say on matters intimately affecting the welfare and even the self-respecting existence of a very numerous class, whose loyal co-operation is as essential to the success of every industrial enterprise as their own.

"Is it clearly recognized that we are at the beginning of a great transition period of industry? Do we realize that the autocracy of capital is coming to an end?"

All this emphasizes the necessity of those organization changes which have been discussed in AUTOMOTIVE INDUSTRIES and which look to the introduction of organization machinery which will give a definite share of the responsibility to the worker and throw open to the decision of the combined worker and governors of industry those matters which affect the welfare and even the existence in a self-respecting manner of the worker. The tendency of the events which have occurred since the armistice was declared in the relations between employers and workers in the various manufacturing countries is very easy to see.

There is a definite demand on the part of the worker for a larger control of the conditions under which he will work and for a larger share in the profits of the industry This tendency has been noted many times in these articles, but it is so important a matter that it must be emphasized again in order that its significance will be thoroughly appreciated. In all the history of the relations of employers and employees as labor and capital since the beginning of the industrial revolution, the issues have never been drawn more clearly than they are drawn today, and the necessities of the case require more thorough and definite attention to the situation with a much closer study of the conditions and a much greater willingness to institute the organization changes which are necessary in order to provide the machinery for the solution of the present troubles.

No other system of organization has been found of any value in the development of industrial work up to the present, except the system which includes some form of representation by the worker and their proper methods of election in the body which has charge of the decision upon the hours of work, the rates of pay, holidays, welfare activities, and other matters that are concerned, under which the worker shall operate. It is interesting to note in this connection that the full plant of the Bethlehem Steel Corporation, which was mentioned in one of the previous articles, includes a complete organization for the joint operation of the worker and the management in all matters relating to the conditions of the worker, and in this respect takes in more detail than is definitely determined in most of such organization plans.

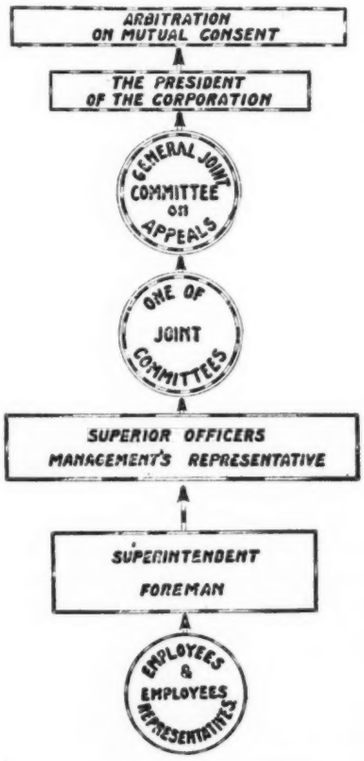

ARBITRATION ON MUTUAL CONSENT
THE PRESIDENT OF THE CORPORATION
GENERAL JOINT COMMITTEE ON APPEALS
ONE OF JOINT COMMITTEES
SUPERIOR OFFICERS MANAGEMENT'S REPRESENTATIVE
SUPERINTENDENT FOREMAN
EMPLOYEES & EMPLOYEES REPRESENTATIVES

Chart illustrative of procedure in the prevention or adjustment of matters arising for settlement

This plan varies from the plans of the other steel companies which have been considered in this series in that it provides for a different representation based upon the size of the plant.

1. Representation shall be on the following basis:

Plants employing under 1500 employees: One representative for each 100 employees.

Plants employing 1500 to 10,000 employees: One representative for each 200 employees.

Plants employing over 10,000 employees: One representative for each 300 employees; provided, however, that in no case there shall be less than ten representatives.

Such adjustments as may be necessary to meet special cases shall be made.

2. For the purpose of applying the unit of representation, the plants should be subdivided according to departments and natural subdivisions. Wherever it is necessary to group a number of small departments in order to complete a unit of representation, regard shall be had to logical groupings and location.

3. Adjustments in units of representation shall be made in accordance with the recommendations of the Committee on Rules.

It has the usual provisions which have been accepted in large organizations for the qualifications of the representative and the elections. It provides for meetings of

the joint committees once every 2 months and for the representatives committees once every month. This frequency of meetings is an important point in the development of any such organization which was omitted from the earlier plans developed in some of the large steel companies, and which omission we noted at the time. The frequent meetings of these committees will do much to get them on a working order and to iron out the difficulties which must appear in the beginning of the organization work.

As we stated previously in considering this point, one of the important factors in this getting together of joint committees is the knowledge which will be gained by the different men of each other and of the respective personalities, opinions and desires. This knowledge itself will operate to clear away a great deal of the suspicion of misunderstanding which is the root of so much labor trouble, and this knowledge cannot be acquired unless the committees meet frequently.

The procedure for adjustment of personal grievances which is considered in this company has the same defect which has been found in a number of these plants. The number of steps which can be taken in order to settle such personal grievances are too many and the judicial procedure is much too involved to serve the purpose adequately. From observation, in a great many plants where some form of review is permitted for the settlement of personal grievances, the writer is convinced that it is not necessary to provide a great many steps of appeal in order to secure thorough satisfaction on these matters.

It is very important, however, that the procedure should not become involved to the delay in rendering a decision until the final result is an irritation in comparison with which the personal grievance is small, instead of a settlement of the matter which will remove the irritation.

Prompt Decisions Desirable

One of the great complaints insisted upon by the labor organization in Great Britain in respect of the Whitely Council which promises so much has been the difficulty of securing a decision from such councils, and the fact that between the action of the councils themselves and the references which had to be made to the central bodies where the council could not reach a decision, too long a time has been involved before the final decision of the final board of appeals could be issued. In the case of the review of a personal grievance, the important matter is to have a review board which by its composition will be above suspicion in the eyes of the worker; then to give that board sufficient leeway for the examination of witnesses and material involved in the case, so that it can render a decision promptly.

There is a tendency in a number of these cases in the judicial procedure of the industrial organization to follow the judicial procedure involved in the courts so as to provide a great many different lines of appeal, growing, finally, in this as in some other cases, out of the organization for the arbitration of the matter. It is not apparent that any good purpose will be served by this, and it may result in conditions of irritation which will destroy to some extent the good effect produced by the development of the representative system of organization. For those interested in the matter the chart presented by the Bethlehem Steel Corporation for both the representative committees and the legal procedure are shown in connection with this article.

During this time of adjustment there is an opportunity to stabilize the industrial establishment to avoid a great deal of turmoil which might ensue unless the adjustment is kept within orderly points, and to build a foundation which will permit the future stable growth of the industrial organization on a basis of efficiency not possible under present conditions. These organization developments which we have mentioned indicate the desire of many industrial establishments to place their business upon such a foundation, and the possibilities involved are important enough to merit the attention and study of every manufacturer.

There is a feeling among manufacturers that organization changes, looking to the removal of the continual warfare which exists between labor and capital, will be made at the

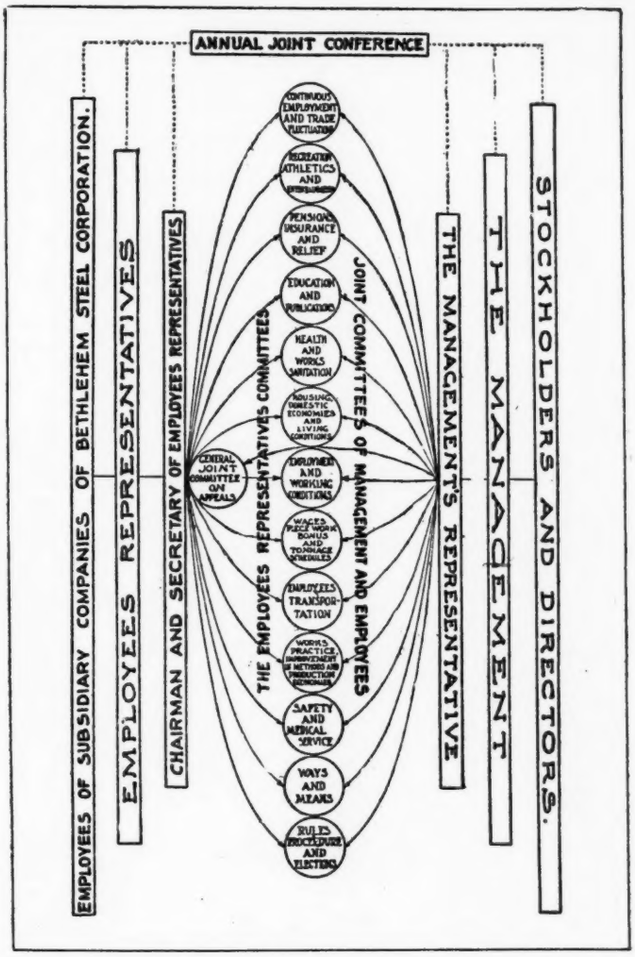

ANNUAL JOINT CONFERENCE
EMPLOYEES OF SUBSIDIARY COMPANIES OF BETHLEHEM STEEL CORPORATION.
EMPLOYEES REPRESENTATIVES
CHAIRMAN AND SECRETARY OF EMPLOYEES REPRESENTATIVES
THE EMPLOYEES REPRESENTATIVES COMMITTEES
JOINT COMMITTEES OF MANAGEMENT AND EMPLOYEES
THE MANAGEMENT'S REPRESENTATIVE
THE MANAGEMENT
STOCKHOLDERS AND DIRECTORS.
CONTINUOUS EMPLOYMENT AND TRADE FLUCTUATIONS
RECREATION ATHLETICS AND
PENSIONS INSURANCE AND RELIEF
EDUCATION AND PUBLICATIONS
HEALTH AND WORKS SANITATION
HOUSING DOMESTIC ECONOMIES AND LIVING CONDITIONS
CENTRAL JOINT COMMITTEE ON APPEALS
EMPLOYMENT AND WORKING CONDITIONS
WAGES PIECE WORK BONUS AND TONNAGE SCHEDULES
EMPLOYEES TRANSPORTATION
SAFETY AND MEDICAL SERVICE
WAYS AND MEANS
RULES PROCEDURE AND ELECTION

Chart illustrative of representation of employees of the Bethlehem Steel Corp. and subsidiary companies

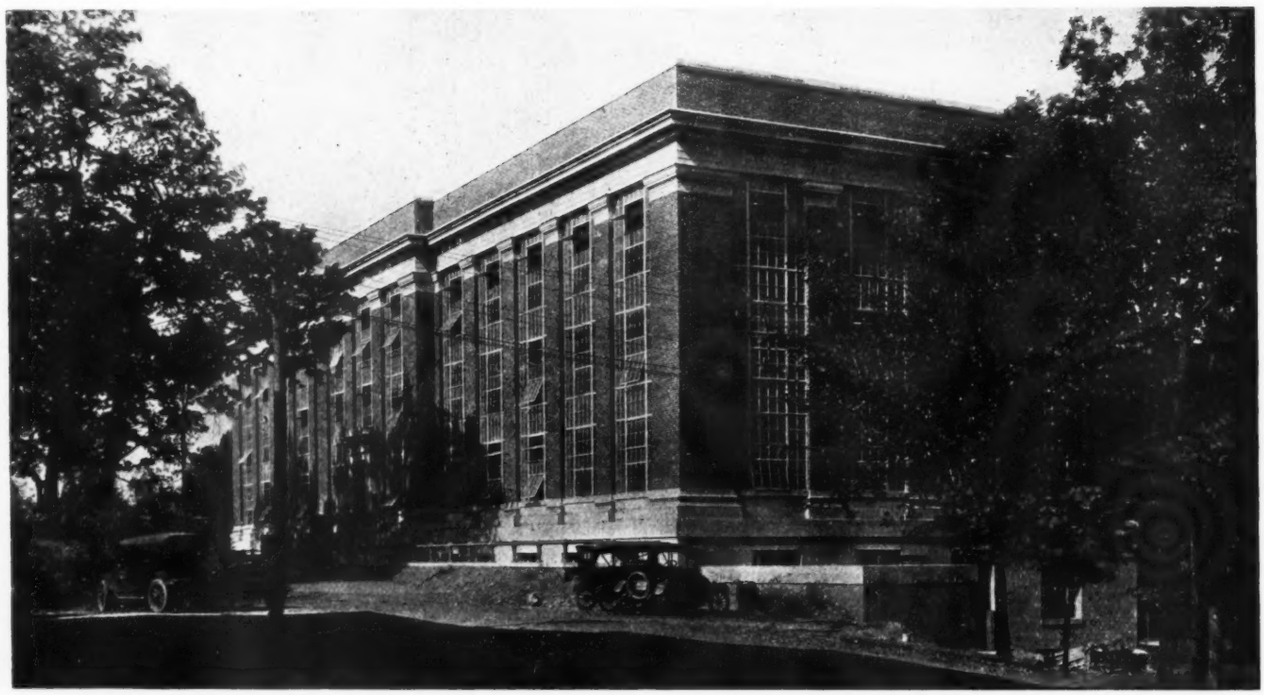
expense of efficiency in production. There is no evidence which would indicate that this attitude is correct in any way. It arises from our old habit of considering the machine as the limiting point of capacity and looking to machine improvement for the development of more speed and efficiency in production.

The history of the industrial development since the beginning of the modern factory system does not indicate that there has been any particular advance in a knowledge of the conditions which govern the personal efficiency of the individual. Its success and its tremendous development have been due almost entirely to the possibilities involved in massing men together for particular operations. In a very large measure, the benefit industrially from massing people together for particular operations has been due to the transfer of the skill from the worker to the machine so that the required efficiency of the individual was not so high, the period of training much shorter and the possibilities of error not so great.

Now that the factory system is thoroughly established and that improvements in machinery come more slowly, the necessity of an increase in the efficiency of the individual laborer is forced upon the manufacturer. Where organization changes have been instituted for several years, so that their effects have become visible, and these organization changes have been based upon sharing the responsibility for the labor condition with the employees, it has been found that the personal efficiency has increased a great deal so that it has been possible to secure a more effective production per dollar of wages outside of the saving secured by the lack of disorder and the elimination of strikes. It is necessary to know this so that the full economic value of such organization changes may be understood.

Industrial Tests by Bureau of Standards

Co-operated Closely During War with Military and Industrial Establishments—Wide Scope of Experiments and Tests—Wind Tunnel for Aviation—Standardization of Master Gages



Metallurgical Building, Bureau of Standards, Washington, D. C.

EDITOR'S NOTE—*Mr. Heldt has just completed an intimate study of war and other technical work performed by the Bureau of Standards at Washington. The following commences a series of articles, each separate and discussing, in detail, the tests, and results secured. The series will be published from week to week.*

FEW people, probably, have any conception of the great expansion during the war of the Bureau of Standards at Washington and of the present wide range of its work. No so many years ago there was little connection between this Government Bureau and the industries of the country. Everybody knew that the Bureau tested thermometers, calibrated weights and measures, and did similar work requiring an equipment of scientific apparatus and the necessary skilled personnel for handling it, but little was heard of co-operation between it and the great industries of the country.

During the period of the war, however, the Bureau has been co-operating closely with these industries and most of all with the automotive industries. In fact, all problems requiring scientific research or accurate tests that came up in connection with war activities were assigned to it.

Naturally the facilities of the Bureau soon proved inadequate to cope with the new work. Building construction has been going on all the time since the beginning of the war, and the personnel has been multiplied more than threefold.

It is an indication of the wide scope covered by standards that the following statement of the functions of the Bureau drawn up some years ago seems to fully cover its activities to-day: The development, construction, custody, and maintenance of reference and working standards and their intercomparison, improvement and application in science, engineering, industry and commerce.

The laboratories of the Bureau, which had been of great use to the nation in times of peace, proved of special importance during the war. Instruments, materials and supplies were on hand which were almost unobtainable elsewhere. Examples of the problems which were referred to the Bureau for solution are those which arose from the failure of the linen supply for aircraft construction and the lack of optical glass, which was formerly obtained exclusively from Germany. Other lines of activity of the Bureau during the past year that grew out of war requirements had to do with ship chronometers and with development work in connection with light alloys.

A very important branch of the Bureau during the past year has been that engaged in the standardization and testing of master gages used in the manufacture of munitions. The work done in this line by the Bureau has proven an important aid to the mechanical industries. Just previous to the declaration of the armistice the gage section of the Bureau had a staff of 140, and a special building has been erected for it. This section of the Bureau has a branch in New York City and maintains laboratories in Cleveland, Ohio, and Bridgeport, Conn. No less than 27,865 gages were tested during the last fiscal year.

Undoubtedly of most interest to the automotive industries is the work that was done in connection with aircraft development. As a matter of fact there has hardly been any line of development in connection with airplanes in which the Bureau has not co-operated in one way or another. This work was carried on under arrangements with the National Advisory Committee for Aeronautics. While the Interna-

tional Commission for Aircraft Standardization was sitting in Washington, much experimental work was done at the Bureau to help in the solution of the problems that confronted this commission. The work of the Bureau covered every detail of airplane design, materials, construction, efficiency of form, motor performance, efficiency of lubrication, carburetion, ignition, choice of fuel, propeller in plane performance, measuring instruments and the appliances required for control.

One of the most interesting investigations now in preparation is that of tests on airplane power plants in free flight. For this purpose six autographic test instruments have been designed, of which three have already been completed. These will automatically record the torque, engine speed, propeller thrust, plane speed, angle of attack and inclination to the horizon. All these factors will be recorded automatically while the plane is in flight, without the instruments requiring the least attention on the part of the pilot.

Much work has naturally been done during the past year by the section on aeronautical instruments, the staff of which was greatly enlarged. This section acted in an advisory capacity to the military authorities and also made numerous tests for them. Further researches are now being conducted with the object of improving the efficiency of altimeters. A special wind tunnel was built at the Bureau, operated by a 9-ft. propeller direct connected to a 100-hp. electric motor. In this wind tunnel it is possible to obtain air speeds up to 90 m.p.h. It serves to test the accuracy of aeronautical measuring instruments and to study the design of airplane parts, stabilizing control devices, the effect of stream lines, plane sections, etc.

The activities of the Bureau during the past year have been too many to be all enumerated here. Most of the work, of course, has been done either directly or indirectly for the Government. Now that peace has come again and that our industries are being directed into new channels, it is to be hoped that the facilities of this great national institution may be made available for the solution of problems confronting the various industries. Why should not our industries in times of peace look to the Bureau for the same assistance which our Government received from it in time of war?

Tests of Airplane Radiators

An Experimental Study by the Bureau of Standards Conducted at the Request of the National Advisory Committee for Aeronautics, Bearing on Head Resistance, Resistance to Water Flow and Weight, All in Relation to Heat Energy Dissipated

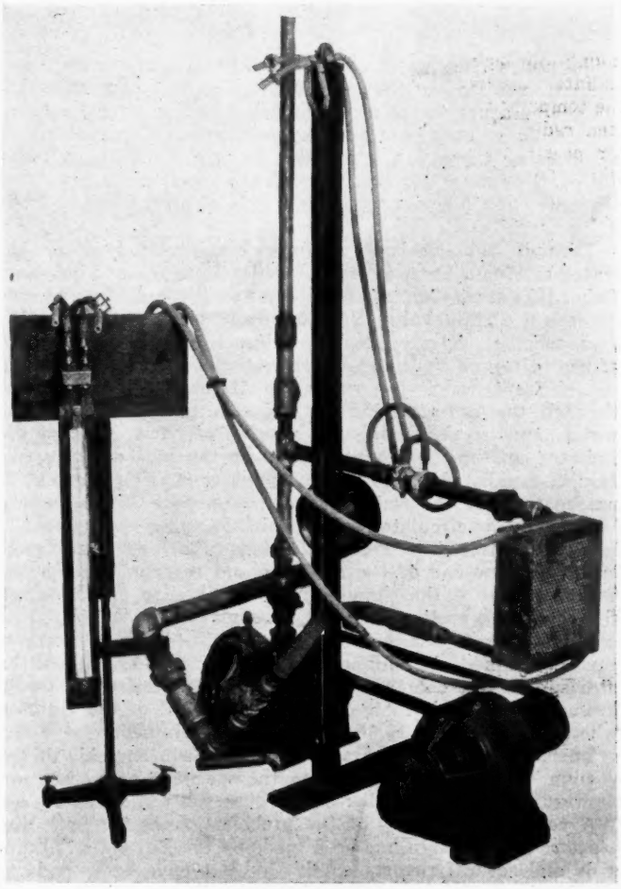
By P. M. Heldt

IF a number of automobile radiators were to be compared on a strictly technical basis, leaving out of account such factors as cost of construction and freedom from tendency to develop leaks, it would probably be agreed that the proper basis would be the amount of heat dispersed per unit of time per unit of radiator weight. In an automobile any unnecessary weight is a detriment, and if a radiator construction can be found which will permit of reducing the weight without loss of cooling qualities, it is an improvement over existing types.

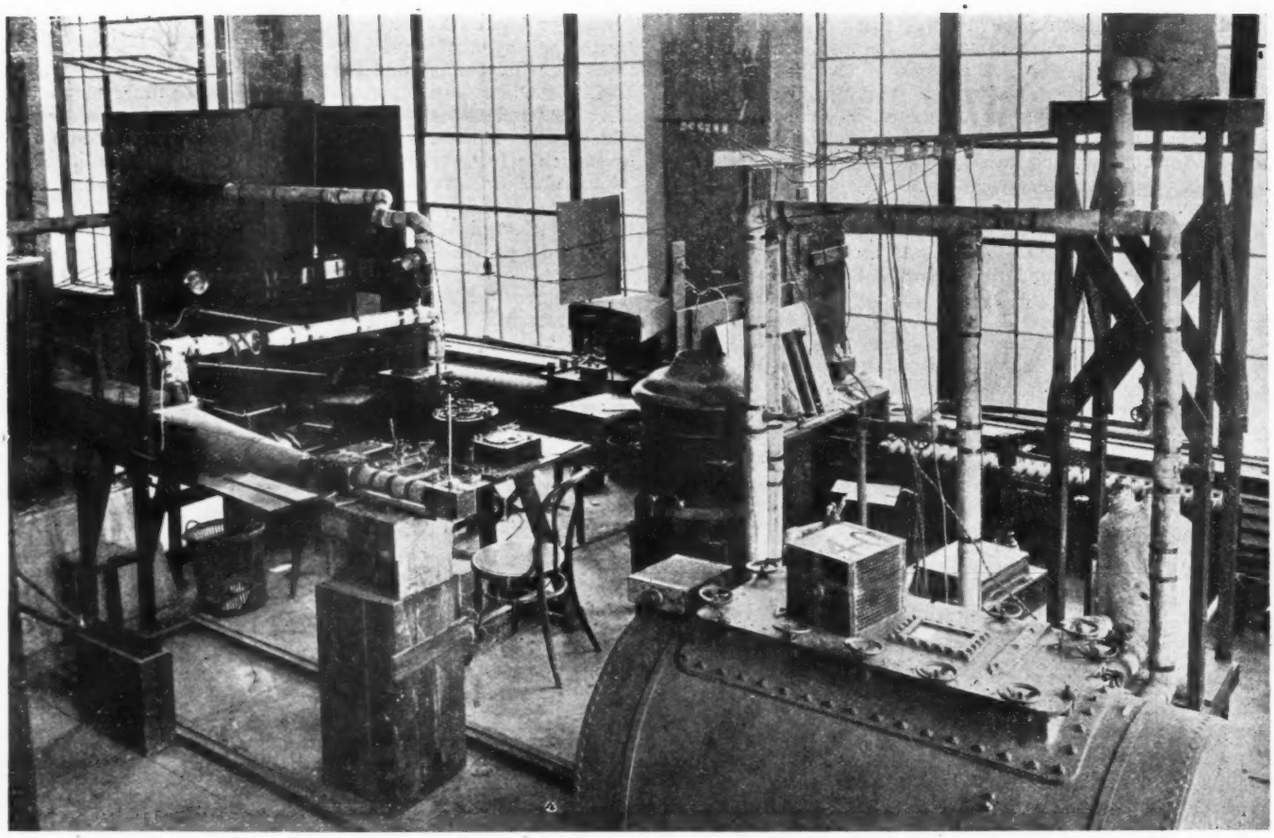
In aircraft work unnecessary weight is far more objectionable than in automobiles, for the reason that the horsepower expenditure in transporting, say, 100 lb. of weight in an airplane at the usual speed is incomparably greater than that expended in transporting the same weight in an automobile. Yet lightness is not the most important characteristic of an airplane radiator. What is required most is a minimum head resistance per unit of heat dissipated per unit of time. The radiator cannot be placed inside the airplane body or in some other location where it merely absorbs the carrying capacity of the plane, but must be located where it is fully exposed to the wind created by the plane's motion, hence it adds materially to the head resistance of the machine, and, other conditions being the same, that design of airplane radiator is best which for a given rate of heat dissipation creates the least additional head resistance.

Test Apparatus Used

At the Bureau of Standards in Washington quite elaborate apparatus has been installed with the object of testing samples of radiator cores with respect to their ability to disperse heat, and their head resistance. These samples, which are made up in uniform sections 8 in. square, are being tested in a vacuum chamber in which the air pressure can be reduced to that corresponding to different altitudes of flight. The air is circulated through the specimen by means of a blower mounted in one end of the chamber. The vacuum chamber is made of boiler plate, with one concave and one convex head. The specimen is placed inside of a wind tunnel made up of 1-in. planking, of square cross section with pyra-



Apparatus used to measure pressure necessary to produce water flow through radiator core



View of the radiator test laboratory

midal approaches at each end. On each side of the specimen radiator are located thermo couple grids by means of which the temperature of the air on entering and leaving the specimen radiator may be accurately measured. The quantity of air passing through the radiator in unit time, or, in other words, the rate of air flow through the specimen, is measured by means of a Thomas meter or a grid of pitot tubes in front of the specimen.

Through the specimen radiator is circulated either hot water or steam from a heating boiler close by. It has been found that when the rate of circulation through the radiator exceeds a certain value, the heat dispersal is practically the same whether water or steam is being circulated. The amount of heat given off by the specimen radiator can be measured in two diffrent ways—by measuring the rate of water flow through the radiator and the drop in temperature of the water, and by measuring the rate of air flow through the radiator and the temperature rise of the air—and the two results usually check to within 1 per cent. The air that is passed through the radiator for the purpose of abstracting heat from it is circulated only within the vacuum chamber. It is drawn through the central wind tunnel by the blower located at one end of the chamber and returns through the outer portion of the chamber where it has to pass through the cells of a cooling radiator through which cold water is circulated. In this vacuum chamber air speeds up to 70 m.p.h. can be obtained. For higher air speeds, up to 120 m.p.h. the atmosphere test chamber is used, and head resistance measurements are made in the large wind tunnel of the Bureau, where air speeds up to 90 m.p.h. can be obtained.

There are glass windows in the top and in one side of the vacuum chamber through which the specimen and other apparatus within the chamber can be observed while a test is on.

A very careful study of the problems connected with aircraft radiator design has been made by the Bureau of Standards and several reports on this subject have been made to the National Advisory Committee for Aeronautics. In its study of the problem the staff of the Bureau had the advantage of access to reports on the same subject made earlier by scientific committees in Allied countries.

There are several distinct types of radiator core construction. Cores in which the air passages are of substantially tubular form are called cellular radiators. The true honeycomb core is a cellular core in which the water can circulate freely in all directions on all sides of each air tube. Water tube cores are cores in which the tubes form the water passages and the air passages are formed by the spaces between these water tubes. In one type of water tube core sheet metal fins are secured to the water tubes and extend out into the air passages to give additional indirect cooling surface, but this type has proved of little value in aeronautic work. Another type, consisting of very flat tubes set edgewise to the air current, has given promise of great value for planes of very high speed.

Definition of Terms

In a radiator the air flow and the water flow are always at right angles to each other. The dimension of the core parallel to the direction of water flow is called its length; that parallel to the direction of air flow, its depth, and that perpendicular to both is called the width of the core. The frontal area is the total area of the core perpendicular to the direction of air flow. While there are three steps in the transfer of heat from the water in the radiator to the air passing through it, it is found that the transfer of heat from the metal of the air tubes to the air is the most important and limits the capacity of the radiator, so that the surface area of the air tubes, which is called the "cooling surface," is the most important factor.

A distinction must be made between direct cooling surface, which is in contact on one side with water and on the other side with air, and indirect cooling surface, which is not in direct contact with the water but to which the heat must flow through a considerable length of metal. The temperature of direct cooling surface is substantially the same as that of the water in contact with it, but owing to the length of the

path of heat flow from the water to the indirect cooling surface, the latter is of considerably lower temperature than the water and the rate of heat dispersal is much less from indirect than from direct cooling surface. In some types of core, pockets are formed in the water tube walls in which there is very little circulation of water, and the Bureau of Standards regards such surface as indirect cooling surface.

Factors Involved

The following is taken from an anlysis made by the Bureau of Standards of the properties which determine the suitability of a particular radiator for use under aircraft conditions:

1—The cooling capacity must be equal to the heat to be dissipated under the worst conditions, that is, when the plane is climbing at its maximum rate from the ground in hot weather. It must also be possible to control the cooling capacity so that the water temperature in the engine jackets will not fall below a predetermined value under conditions of most rapid cooling, as when diving or when flying at high altitudes in cold weather.

2—The head resistance of the radiator has an important influence on the total amount of power required for propelling the plane and is a factor in determining its aerodynamical properties.

3—Another important factor is the combined weight of the radiator and the water contained by it. This affects the balance of the plane as well as the power required to carry the radiator.

4—If the head resistance of the radiator is known, the power required to overcome this resistance at any given speed may be readily calculated, as may the power required to carry the radiator, which is simply that proportion of the total brake horsepower usefully expended which is represented by the ratio of the radiator weight to the total loaded weight of the plane.

5—The pressure required to force the water through the radiator is a factor.

6—It is desirable to have a simple means of comparing the relative values of different radiator constructions. It has already been stated that the criterion of radiator merit is that it shall absorb the least power for the given rate of heat dispersal. As it is possible to express the heat dispersal in horsepower, the ratio of heat dispersal to energy absorption due to the head resistance and weight of the radiator will be a simple number which will be the same irrespective of the units employed. This figure for any particular radiator is called its figure of merit. The best airplane radiator for "free air mounting" is that having the highest figure of merit.

In making a study of different core constructions, the Bureau took note of the following features:

1—The form of the air and water passages.

2—The depth of the core.

3—Quality and thickness of the metal.

4—Weight of the core empty and of the water contained.

5—The free area of the air tubes, defined as the percentage of the total frontal area occupied by the free cross section of the air tubes.

6—The hydraulic radius of the air tubes, that is the area of the tubes divided by their combined perimeter.*

7—The ratio of length of air tube (depth of core) to hydraulic radius.

8—The cooling surface in square feet per square foot of frontal area.

9—The proportions of direct and indirect cooling surface.

10—The dimension of the water tubes, including the length in the direction of flow for a section of the core 1 ft. long, the width of the tubes, the thickness and the hydraulic radius, all expressed in inches.

11—The cross sectional area of the water tubes normal to the direction of flow. With uniform tubes this is equal to the area of a single tube normal to the direction of flow, multipled by the number of tubes per foot of width.

Factors in Radiator Operation

Following is an enumeration of the factors entering into the operation of a radiator:

1—The mass flow of air through the core, which may be defined as the rate of flow, in pounds per second through a unit of frontal area.

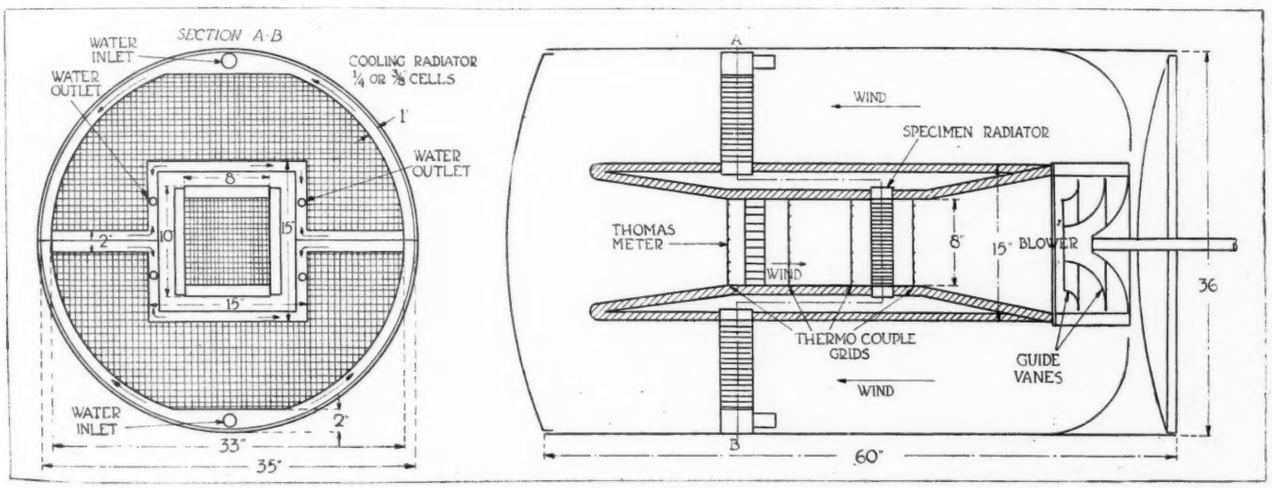
2—The temperature difference between the air and the water. This is taken as the difference between the arithmetic mean of the entering and exit temperatures of the water and the temperature of the entering air, in degrees Fahrenheit. It is pointed out in this connection that for the highest degree of accuracy the logarithmic mean of the water temperature should be used, but as there is little difference between the logarithmic and arithmetic mean, the latter is used for the sake of simplicity.

3—The air density, which is taken at 0.075 lb. per cubic foot at ground level.

4—The flow of water through the core, in gallons per minute.

5—The nature of air and water flow through the core, reference being made particularly to the difference between stream line and turbulent flow. When the flow is turbulent the exchange of heat between the fluid and the surrounding wall is much more rapid than when the flow is of a stream line character. Turbulent flow is obtained at all speeds met with in airplane radiators. The speeds required to produce it are smaller the larger the diameter of the tube. When a fluid flows around an obstruction not conforming to the

*Since the cooling surface of a plain cellular radiator is very nearly equal to the depth multiplied by the perimeter of the air tubes, the hydraulic radius of the air tubes for such a core may be obtained by dividing the total volume of the air tubes, i.e., the free area multiplied by the depth, by the total cooling surface. This has the advantage of being a quantity which can be found for noncellular types of radiator.



Two sectional views of vacuum chamber for calorimetric tests of specimen radiators

stream line form, turbulent flow is produced even at low velocities, this being referred to as artificial turbulence.

In the work of the Bureau of Standards on radiator cores, the properties of the cores were defined as follows:

1—The energy dissipated is expressed in horsepower per square foot of frontal core area and for a standard temperature difference of 100 deg. Fahr. It is intended that the rate of water flow when this figure is attained should be high enough to produce turbulence.

2—The weight of the core in pounds per square foot of frontal area, both empty and with the water required to fill that section of the core.

3—The head resistance of the core, which may be defined as the force which would be exerted on the radiator if it were supported in a free air stream which produces the given mass flow.

4—The mass flow of air through the core when supported in a free air stream, which for all ordinary types of core has been shown to be proportional to the free air speed to which the core is subjected, so that if the proportionality factor has been once determined the mass flow for any free air speed, in pounds per second per square foot of frontal core area, may be readily found. This proportionality factor, which is based on air density of 0.075 lb. per cubic foot, is called the mass flow factor of the core.

5—The energy absorbed by the core under free air conditions in horsepower per square foot of frontal area.

6—The figure of merit of the core, which is obtained as described for a radiator.

Head Resistance Problems

Among the problems which it was proposed to study by the Bureau of Standards are the effect of the nature of the cooling surface and the effect of depth on the head resistance of a core. It is pointed out that the head resistance is composed of two factors, namely, the force due to impact on the front and rear areas of the metal and the effect of skin friction in the tubes which exerts a drag on the core. This latter effect may be obtained by measuring the pressure drop within the tube over a portion of its length. This factor alone will vary with the depth of the core if the entrance and exit of the tubes are constant, and so the head resistance of the core as a function of the mass flow can be computed if the resistance of one depth of core and the drop through the tubes per unit length are obtained.

Procedure of Tests

In the experimental work that has been done, a large number of standard specimens of various types of core obtained from manufacturers were submitted to 5 series of measurements:

1—Measurements of the physical dimensions of the specimens, the average value for the entire specimen being obtained as accurately as possible.

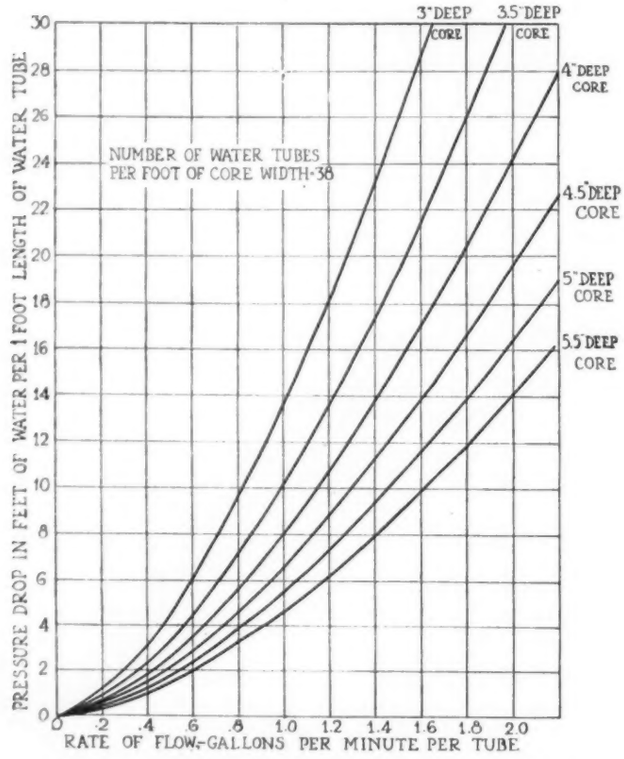
2—Measurements of the energy dissipated for various mass flows and under various conditions of air density; rate of water flow and temperature. These experiments were made in tunnels in which all the air flowing through the tunnel is forced through the tubes of the specimen, so that the mass flow is actually measured.

3—Measurements of the mass flow of air through the core under free air conditions were made in the 54 in. wind tunnel of the bureau by means of a specially designed air venturi.

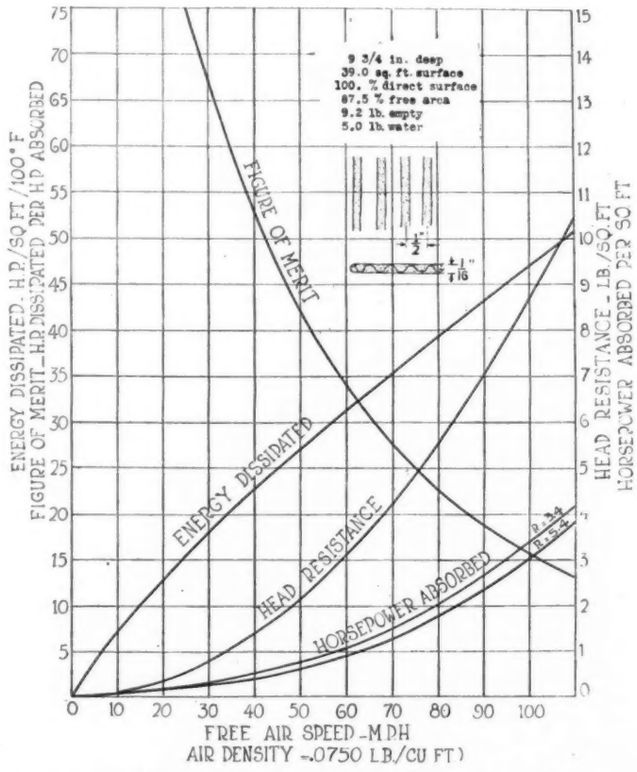
4—Head resistance was measured also in the large wind tunnel by mounting the specimen on the arm of a balance.

5—Some work has been done on the pressure required to produce water flow through the core, though the opinion prevails that this test should be made on complete radiators.

The mass flow through a core supported in free air can be obtained from tests made in a wind tunnel, but if the flow of air through or around the core is in any way obstructed, it is necessary to study the performance to some extent in position on a plane in flight. The simplest method of determining the thermal properties of a radiator in any location is to determine the mass flow through various parts of the core, as with this data at hand the heat dissipated can be calculated from laboratory tests. A plan for measuring the mass flow through a radiator core in flight has been laid out but has not yet been carried out. Another problem to be studied is the amount of heat per brake horsepower of the engine that must be dissipated in flight, and the effect of cowling of the engine on this factor.


3" DEEP CORE
3.5" DEEP CORE
4" DEEP CORE
4.5" DEEP CORE
5" DEEP CORE
5.5" DEEP CORE
NUMBER OF WATER TUBES PER FOOT OF CORE WIDTH-38
PRESSURE DROP IN FEET OF WATER PER 1 FOOT LENGTH OF WATER TUBE
RATE OF FLOW-GALLONS PER MINUTE PER TUBE

Pressure required to force water through core at different rates



Curves showing results obtained with a flat tubular radiator core

The results obtained in the experimental work were expressed in the following form:

1—A table of core characteristics.

2—Curves showing the heat dissipated, the head resistance of the core, the power absorbed with an average lift-drift ratio for the plane, and the figure of merit under given assumptions at various mass flows of air, together with an auxiliary scale showing the equivalent free air speed, that is the free air speed which, striking the core unobstructed, would cause the same mass flow and consequently the same dissipation of heat, head resistance and power absorption.

3—General relations showing how the properties of the core vary when the conditions of use are changed.

4—Data showing the relation between the conditions under which the radiator is to operate on the plane and the conditions under which the parts of the core operate.

Method of Using Results

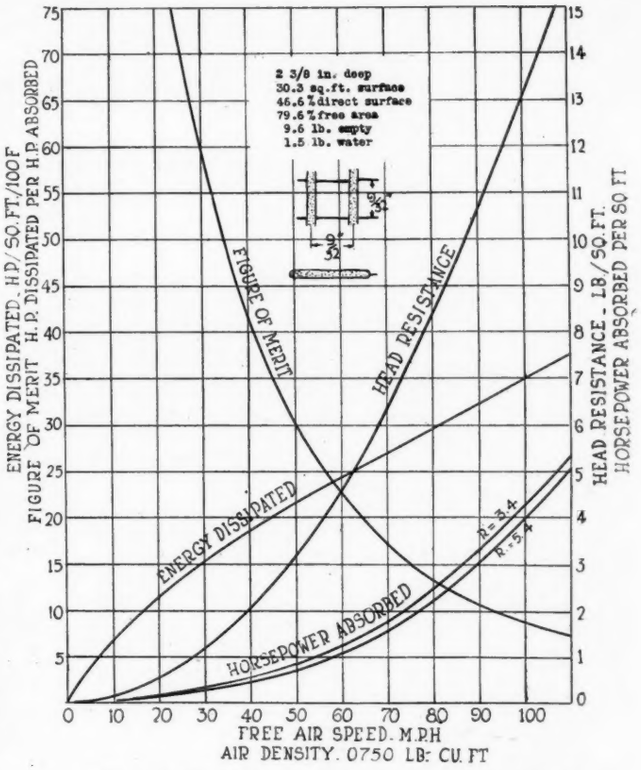
By means of a few simple rules the experimental results can be applied to a predetermination of the performance of an actual radiator on a plane. In the first place, the energy dissipated by a core of any size is directly proportional to the frontal area. In applying this rule the mean temperature of the water in the whole radiator must be used in computing the temperature difference.

The weight of the core of a radiator is directly proportional to the frontal area, but, of course, the weight of the water tanks and of the water they contain is in some cases a considerable factor. Experiments have shown that the resistance of a radiator core is substantially proportional to its frontal area. The effect of the tanks must be allowed for, as must also the effect of location. The power absorbed by the core is also directly proportional to the frontal area.

The pressure necessary to produce water flow is given not for a square foot of frontal area but for a section of core 1 ft. wide and 1 ft. long; in other words, it is the pressure per foot of length necessary to produce the given flow per foot of width. It is then necessary to divide the total flow desired by the width of the core to obtain the flow per foot of width, in order to be able to find from the data the pressure drop per foot of length, and then multiply this by the total length of the core to obtain the total pressure drop. When the widths of different parts of the radiator are different, and when there are intermediate tanks, as around the propeller hub, corrections must be made.

The figure of merit of a radiator is computed from the power absorbed and the heat energy dissipated. If the effect of the tanks is neglected the figure of merit depends on the core structure and on the location on the plane, but not on the frontal area.

For a radiator to be mounted in a free air position on the plane, so that the effect of location on the properties of the radiator is negligible, the figure of merit for the core is the fundamental criterion. When a radiator is placed in an inclosed position, as in the nose of the fuselage, the mass flow of air through it will be less. In general the mass flow will be decreased less relatively in a radiator of high resistance than in one with an open type of core. For given mass flow the resistance of a radiator in an inclosed position appears to be considerably greater than under free air conditions. Similarly, the absorption of power is greater and the figure of merit lower. There has been a tendency recently to place the radiator in the plane of the wing. In that case the air flows upward through the core, decreasing the lift of the wing but producing little effect on the resistance. It is believed that for this mounting a core of very compact structure would be preferable.



Test results obtained from a cellular effect core

Spring Tires Used by German Army

SINCE practically all imports of rubber into the Central Empires ceased with the outbreak of war in 1914, and mechanical vehicles are used very intensively in modern warfare, it is no wonder that rubber was a very scarce article in Germany toward the end of the struggle. It appears that synthetic rubber is now a regular article of manufacture, and a recent report has it that a works at Leverkusen turns out 165 tons of this product a month, but it seems this finds application chiefly for insulating purposes, for which it is said to be superior to natural rubber.

At any rate, vehicles attached to the German army on the Western Front were fitted with a combination steel spring and leather tire and a section of such a tire has been sent to the B. F. Goodrich company by Capt. August Barth, who is serving in France with the 303d Repair Unit of the Motor Transport Corps. It was from a vehicle of the personal messenger and body guard of Prince Eitel Frederick, it is claimed.

In his letter Captain Barth said this type of tire was used extensively by the Germans and that it proved fairly satisfactory when the roads were good and the rate of speed moderate. It was practically useless when excessive speeds were called for because the radially mounted spiral springs became easily misplaced when turning corners or when obstacles were encountered. The spring tire sent by Captain Barth contained three plies of spring steel on the outer band on which was bolted a heavy strip of leather.

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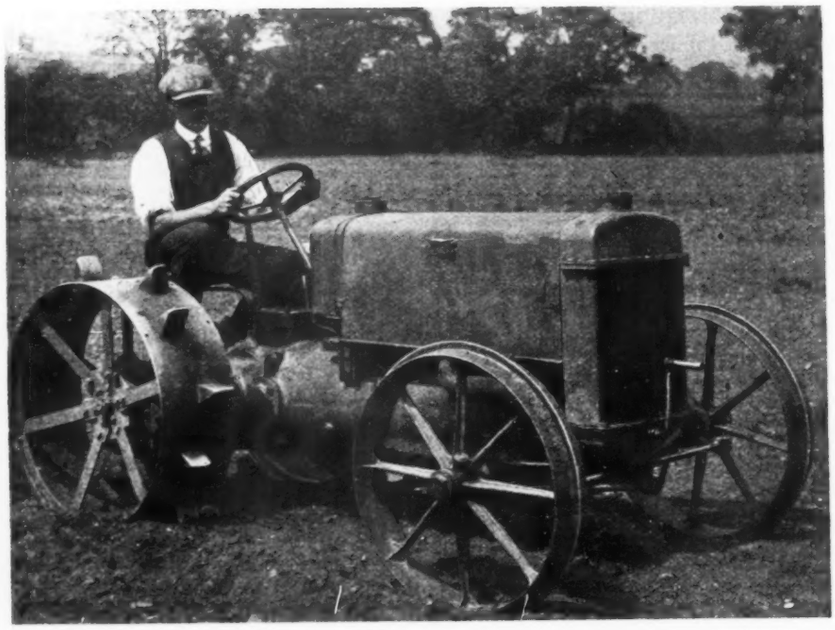
AN active propaganda in favor of road improvement is being carried on in England by the Automobile Association and Motor Union. Just previous to the recent Parliamentary election the organization circularized candidates to secure their support for legislation for the reconstruction of roads upon lines suited to modern traffic, for the assurance of a sufficient supply of fuel at a reasonable price, together with the encouragement of home-produced fuel, and an up-to-date Motor Car Bill under recognized auspices. Of the 341 replies sent 276 were in entire agreement and none were hostile.

The Austin Farm Tractor

A British Tractor on Fordson Lines Which It Is Anticipated Will Sell at $1,000



A new British tractor on Fordson lines manufactured by the Austin Motor Co., Ltd., Birmingham

LONDON, ENGLAND, Feb. 4.—The frameless form of tractor continues to find favor among European manufacturers. The model shown is being introduced by the Austin Motor Co. at Northfield, Birmingham.

The trunk or tubular casing is made up of four cast-metal sections, flanged and bolted together. Of these the foremost section is a transverse bracket which carries the radiator on a trunnion about which the front axle beam is free to oscillate, but is held against a fore and aft displacement. The second, third and fourth sections of the casing compose the engine and clutch, change-speed gear, and axle-gear units. The gross weight is under 2912 lb., but a large driving wheel of 3½ ft. diameter by 10 in. wide is being substituted for the present dimensions of 3 ft. by 14 in.; it is anticipated that the gross weight will exceed slightly that tare.

Engine with Four Cylinders En Bloc

The engine has four cylinders *en bloc*, with a detachable head which covers the valves, the usual protruding side pockets being avoided. The cooling is by natural or thermal circulation through large bore pipes. The bore and stroke of the cylinders and pistons measure 3¾ in. x 5 in. A crankshaft speed of 1200 r.p.m. is the normal rate.

The engine is started on gasoline and then runs on kerosene, a Zenith carbureter being used for both fuels, with a change-over valve interposed in the fuel pipe line. The output at normal speed is about 25 hp. The engine shaft has the unique feature among tractor engines with *en bloc* cylinders of five main journals, with suitable provision for their adequate and direct pressure-fed lubrication by a pump. Ignition is by a high-tension magneto with fixed firing point.

The power is transmitted through a pressed-steel cone clutch having a self-cushioning engagement through the medium of interposed under-periphery springs. The cone is faced with asbestos fabric, which can be removed in a short time without dismantling the clutch. The transmission is through a bevel-geared first-motion shaft, which also carries a belt pulley on its end, which is carried through the casing. This gearing is so arranged that at normal engine speed the pulley shaft speed is about 330 revolutions per minute. It is intended to provide three speed changes for the driving wheels; at present there are but two rates through a second motion shaft and a large spur-gear wheel in the axle casing, the latter gear wheel combining the differential or axle balance mechanism.

The driving wheels are of the built-up light traction engine pattern, and are secured to the axle ends by splines of integral feather-keys. The main journals revolve about Timken roller bearings, and the rear wheel hubs and the fore axle have rubber buffers for cushioning shocks. The fore end of the tractor casing is suspended on coil springs; the rear portion is springless, as is usual with tractors designed for land work. The steering lay-out follows the Ackermann system, with the cross bar placed in front of the axle beam. The price first mentioned is $1,000, and its listed capacity is a two-furrow plough.

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A LARGE bombing machine built at the Farman aircraft works in France, which has been named the Goliath, is being adapted for use in passenger service. Seats have been installed running the length of the fuselage, large lateral windows have been fitted for sight-seeing, and a flight to London on this big twin-motored machine is contemplated as soon as fine weather sets in. The two Salmson engines give 540 hp., and the anticipated speed is in the neighborhood of 90 m.p.h., with a relatively slow landing speed. Internal heating apparatus has been provided, and on a regular run the machine should carry 30 passengers with comfort.

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SOME experiments bearing on the importance of properly focusing bulbs in headlamps are reported in the *General Electric Review*. With a 10-in. headlamp and 21 candlepower Mazda lamp, it was found that the beam of light was reduced to 31 per cent, if the filament was 1/16 in. out of focus, to 18 per cent with ⅛ in. error, and was only 4 per cent of its proper power if the filament was misplaced to the extent of ¼ in.

Automotive Industry Just Stripped for Action When Germany Quit

Contributed Many Unusual Products and Heavily of Employees and Executives to Uniformed and Civilian Service—Some Interesting Sidelights

By J. Edward Schipper

THROUGHOUT the country manufacturers in the automotive industry are ruefully surveying great rows of machinery and great piles of shell blanks and other raw materials stored in various parts of their factories. Hundreds of accountants are busy making up claims to be presented for adjustment and hundreds of millions of dollars are temporarily tied up awaiting approval and payment of the claims. Working its way through the country is the feeling that the Kaiser quit just about a year before he should have, in order to see what this country could do after it had fully gotten into action.

The final chapters are now being written on the participation of the automotive industry in the government war program. The books are being closed on what has been the most eventful two years the industry has ever spent, and while the readjustment period is a difficult one, it is in the main being handled efficiently by the manufacturers who are endeavoring to get back into production. It must be confessed, however, that the industry is still sadly torn up and disarranged because the order of the government to be on 100 per cent war work by the first of January, 1919, meant the tearing out of all the production methods and machinery in every plant which was not so fortunate as to secure orders for its standard products. New government machinery had to take the place of the production machinery formerly employed. Generally, the machinery used in automobile manufacture was too light for the heavier products, such as shells used in government work, and consequently many shops did not have a machine standing in its original place. With the financial backing of the government, however, and with everything cleared out of the way for the purpose of winning the war, it was much easier to get into war work than it was to get out of it. Former sources of supply are just as disrupted as the factories, so that it is impossible to start manufacturing automobiles in many instances without the threat of a much unbalanced inventory, owing to the inability of parts makers to deliver on schedule.

This leads back to the interesting question of what did our industry do during the war. What was accomplished which merited this disruption and confusion? The history of the larger companies has become more or less well known where the work has been of a spectacular nature, but hundreds of smaller concerns which made every sacrifice to do their bit, and which in hundreds of instances are now threatened with financial disaster because of this work, have been passed by unnoticed.

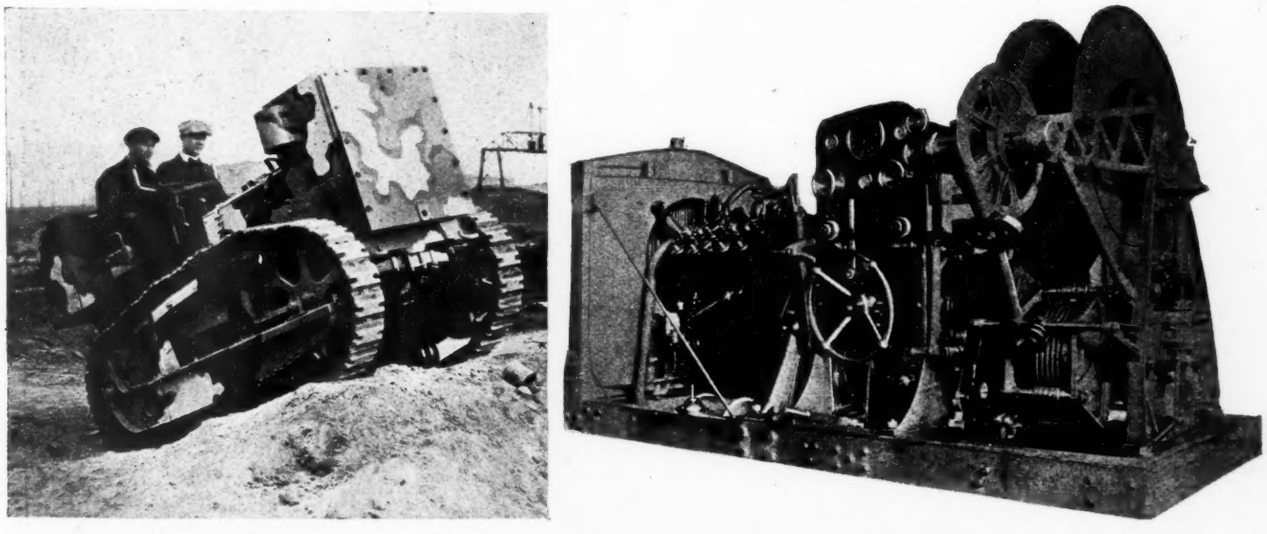
What the Industry Did

There is no more interesting phase in the study of what the automotive industry did during the war than the survey of the products which the different factories made and which in many instances were far different from anything that they had ever previously attempted. For instance, we find the Willys-Overland Co. making the OX-5 training plane engines, 77-mm. gun carriages, 8-in. shells, Liberty eight engines, Liberty twelve engines, Mark III adapters, types A and B lifting plugs, Sunbeam airplane engines and military tractors for the British government, and a miscellaneous assortment of smaller parts.

Packard and Ford, as is well known, did a tremendous work in the development and manufacture of the Liberty aircraft engine. In addition, the Packard army trucks left in a continuous stream during the entire period of their participation in the war. Besides, there were militor tractors and many small gun forgings made at the Packard factory.

Maxwell made 6-ton trucks, Ford was just starting big production on a small two-man tank, and Locomobile made the first of the Mark VIII 35-ton tanks, besides great numbers of Riker trucks.

The Hudson company made the transmissions for the 6-ton



Left—2½-ton artillery tractor driven by a Cadillac eight-cylinder engine. Right—Eight-cylinder Cadillac engine being used as a motive power of a balloon winch to lower observation balloons

General view of the larger of two machine rooms at the Willys-Overland Co. Building and equipment especially designed and built for 8-in. shell production

tanks. It also had a contract for making Nash Quad trucks, and the company was shortly to engage in the manufacture of the higher speed types of 6-ton trucks, equipped with its own Super Six engine.

When the armistice was signed the Olds Motor Works was in the midst of diverting its entire facilities, including both plant and organization, to Liberty engine work on an extensive scale. Large factory additions were under construction, and between a million and a million and a half dollars' worth of equipment had been ordered, all with a view of taking on about two thousand workmen in addition to the regular force of 1500. It was expected that this concern would be in production during the early part of January. Work was stopped with the signing of the armistice, and by now the plant is nearly up to normal production.

Dodge Bros. went into artillery manufacture. Shortly after war was declared the United States went into the manufacture of the 155-mm. howitzer and the 155-mm. Filloux rifle. These guns required a hydraulic recoil or recuperating device, but as none of this mechanism had ever been built in America, the problem involved the gigantic task of not only constructing a special plant, but the designing and making of special machinery and tools. Dodge Bros. put up a plant valued at $10,000,000 and for months have been shipping these vitally important parts. These recoils permit the gun to return to normal in 13 seconds when fired at an angle of 45 deg. They are made from billets of steel, that for the rifle weighing 7800 lb.

The Hupp Motor Car Corp. made tools and gauges for subcontractors, ordnance shell parts, tank parts, engines, light trucks and heavy truck parts, and this concern is stated to have been just about ready to take on a wide variety of additional work.

No one would ever picture the Haynes Automobile Co. building Buda engines or Quad transmissions, and yet both these products were on the Haynes program of war work.

The smaller production companies, such as Harroun, turned out thousands of the 155-mm. long-range high-explosive shells. The Templar Co. of Cleveland made the same type of shell; the Dort company, in place of the small touring car and roadster, turned out in quantities of perhaps 15,000 a year, turned its attention to cargo trailers and then to the G. M. C. ¾-ton truck, kitchen trailers and special truck bodies. Reo made army tractors.

The Grant Motor Car Co. turned out 612 anti-aircraft gun trailers, 830 3-in. field gun trailers, 576 4-ton shop trailers and more than 200,000 155-mm. Mark V shells.

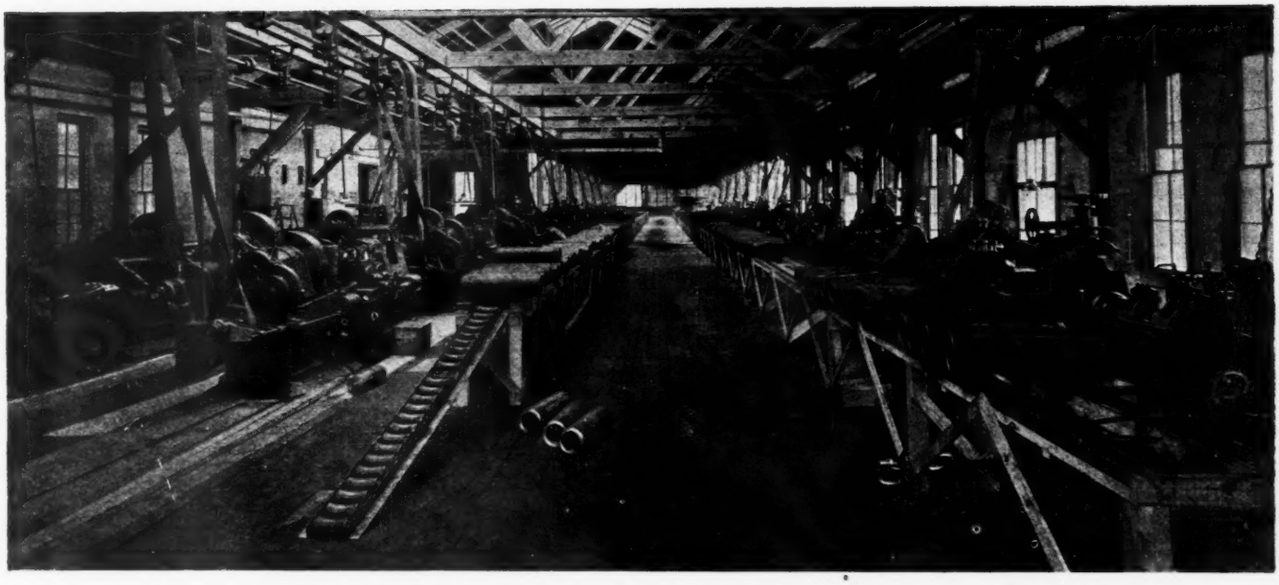
The electric car companies were not behind in this work, as is evidenced by the Anderson Electric Car Co., which turned out ambulance bodies for the G. M. C. chassis.

All of the above are random examples of work done by the passenger car manufacturers along lines which were different entirely from their standard products, and they were not alone in this. The truck manufacturers also did work which was a radical departure from anything they had previously been accustomed to.

For instance, the Avery Co. was just about ready to start on self-propelled big gun mounts; the Bates Tractor was making parts for the 4-in. gun mounts; the Columbia Motor Truck & Trailer was making four-wheel trailers for the Quartermaster's Department; the Federal Truck was making artillery tractors; the Kelly-Springfield made 1225 heavy aviation trucks; the United Motors also made heavy aviation trucks. The Class B trucks were made by such concerns as the Gramm-Bernstein, which contracted for 1750, the Lewis-Hall Iron Works, the Service company and J. C. Wilson, the latter concern also having contracted for the Wilson 2-ton and Class AA trucks.

Axle manufacturers also departed radically from their lines in many instances. For example, the Empire concern made airplane propeller hubs and flanges, and airplane drive shafts; the Salisbury Axle Co. made 3-in. anti-aircraft shells and military truck parts, such as drawbars, bumpers, sprag releases, assemblies for Class B trucks, also the front and rear Quad axles.

Rows of Liberty engines on their way to and from the testing sheds



Shells for 115-mm. guns in process of manufacture at the Grant Motor Corp., Findlay, Ohio

The engine manufacturers were generally fortunate to be turning out nothing but engines. However, these engines varied greatly from their standard practice, but now that they have proven themselves in government service will probably be manufactured in a commercial way. Continental, Hinkley, Wisconsin, Hercules and others made the Class B military engine. A variety of truck engines was made by such concerns as Waukesha and Continental, who, in addition to the Class B engine, made four and six-cylinder engines for light ambulances for the medical department, light ordnance trucks, Class AA government trucks, light aviation trucks, heavy aviation trucks, quartermaster trucks, trucks for the Navy, trucks for cantonment camps, fire brigades and the light and heavy Signal Corps work.

Class B clutch and transmissions required the efforts of such concerns as the Covert Gear, Detroit Gear & Machine, Fuller & Sons, Muncie Gear Works, Warner Gear and T. W. Warner. The Grant-Lee company made gears for the F. W. D. trucks, and the American Die & Tool made airplane parts and also got into armored tank production, locomotive building, shipbuilding and kindred lines.

Body Makers Turn to Airplanes

The body manufacturers were in big demand for all sorts of government purposes. The Fisher Body Co. was in a position to turn out 200 airplanes a day when the armistice was signed. It produced large numbers of De Haviland planes and also the training type of planes. The Lang Body made boxes for the Browning machine gun and trays for ammunition. This concern also mounted and crated the reconnaissance and machine gun trucks and did the camouflaging work on these trucks. The Rubay Co. got into airplane work; the Markley Commercial Body Co. produced airplane cylinder boxes and wedges for shipment. Ambulance and transport bodies were made by Erdman-Guider, the Highland Body Co., the Motor Truck Body Co. and the Trippensie Mfg. Co. Escort wagon parts were made by the Sidney Mfg. Co. These are chosen from a wide list, showing the great variety of work that was done in this field and gives some sort of a picture of the disruption necessary in the industry to produce the required material for the government.

Even before this country had declared war, the United States had begun to place contracts with different concerns for war material. For instance, the Peerless company received its first United States contract in June, 1916. During 1917 a great number of contracts for war materials were of course placed, war having been declared in April, 1917, with this country in a tragically unprepared condition. As a result of this, it was not until December that contracts began to be placed rapidly for war material, although we had declared war in April.

During the month of December, Hudson, Reo and a number of others received their ordnance contracts. The airplane contracts received by Packard and Overland were somewhat in advance of this and much nearer the declaration of war. Many of the shell contracts such as Harroun were not placed until March, 1918. Dort received its contract in February, Hupp in May, 1918; Anderson in May, 1918. Saxon and Liberty did not receive their contracts until August, 1918, and the Crow-Elkhart in December, 1918, showing the immense advantage which would have been possessed if this country had utilized the 3 years of war on the other side to get into a real state of preparedness.

A great amount of new plant area was added by the industry during the war, and this is going to be of advantage as soon as the industry gets its stride. At the present time much of it is superfluous. However, the prospects for getting back into bigger production than ever before are so good that any added plant space is not looked upon as a liability, but an asset.

The Willys-Overland Co. added 391,374 sq. ft. for war purposes, the Hudson company added 30,000 sq. ft., Packard added 300,686 sq. ft. for government purposes alone, the manufacture of passenger cars being completely eliminated during the war. The Anderson Electric Car Co. put up a two-story building, 360 ft. by 120 ft. wide. The Federal Motor Truck put up a $250,000 addition; the Gramm-Bernstein more than doubled its plant capacity since the beginning of the war; the Indiana Truck Co. added 53,000 sq. ft.; the Kelly-Springfield built two buildings, one 450 by 62 and the other 592 by 62 ft. The Lewis-Hall company devoted 26,000 sq. ft. of floor space to its Class B contract; the Service company put up a building 775 ft. long by 75 ft. wide; Standard added 18,000 sq. ft., and the United Motors Co. 5400 sq. ft.

Parts and Accessory Makers Also Enlarged Plants

The parts and accessory makers also erected plants and greatly increased their space. For instance, the Continental Motors Co. added 200,000 sq. ft.; the Waukesha increased its plant area 40 per cent; the Warner Gear put up 87,000 sq. ft. in new buildings; T. W. Warner increased its plant by 300 per cent.

The body companies were noticeable in their increase, led by the Fisher Body, which put up an entirely new 10-acre plant to take care of airplane work. Rubay put up 90,000 sq. ft., the Lang Body 24,000 sq. ft., and Erdman-Guider and the Motor Truck Body each 12,000 sq. ft.

The value of the production turned out by the automotive

industries for the government during the war amounts to billions of dollars. It would be hopeless to attempt to list the articles manufactured here or to give any idea of the quantities and the value in money. Taking the Peerless company alone, $37,000,000 worth of trucks were furnished by this one company. As another random example, the Dort had orders for approximately $6,000,000 worth of work, about one-half of which was completed. To give an idea of the quantity of materials that this means, it may be interesting to take other typical examples. Packard delivered over 6,000 trucks, more than 550 Liberty engines, and they were just getting into quantity production on La Pere planes. The Haynes company had completed 4,000 engines and 600 transmissions. Reo turned out 1560 army tractors.

Parts Makers Also Busy

Among the truck manufacturers, when the armistice was signed, Federal had made 1465 trucks and 200 tractors and manufacture was still going on. The value of these trucks was $5,650,000, with $2,000,000 additional in parts. The Gramm-Bernstein had turned out 1750 Class B trucks, the Indiana Truck Corp. 1045 trucks and about 1,000,000 pieces of small machine parts.

The parts makers were not far behind the manufacturers of complete vehicles in the money value or quantity of production turned out during the war. The Standard Parts Co., Cleveland, had completed approximately $10,000,000 worth of manufactured articles for the government; the Covert Transmission about $3,000,000; Rubay, $5,500,000. Continental had turned out 60,000 engines; Hinkley, 3600 up to Nov. 27, 1918; Wisconsin, 15,000; Waukesha, 4500. The Detroit Gear & Machine Co. had made 8000 clutches up to the end of December; Grant-Lees, 2000 sets of gears for four-wheel drive trucks; Warner Gear Co., 6500 transmissions, 700 clutches, 10,000 control sets, 4500 differentials and 5000 steering gears. T. W. Warner was running at 500 transmissions a day when the armistice was signed.

Contributed of Their Personnel

Outside of contributing all of this manufactured production, of which it must be realized the examples given are only scattered instances taken at random from our long list of manufacturers, the automotive companies were also heavy contributors of personnel, not only to the uniformed service, but to the civilian departments of the government. From the Willys-Overland Co. alone 5500 skilled and unskilled laborers entered the service. This is approximately 33 1/3 per cent. This same percentage was reached by other concerns; for instance, the Liberty Motor Car Co., of which 34 per cent of all people employed, including the office and factory force, entered the service. At the Grant factory 584 were enlisted or drafted, or about 65 per cent of the laboring force. To take other typical examples of the number of skilled and unskilled entering the service, Dort lost 180, or 15 per cent; Hupp, 287, or 25 per cent; Anderson, 100, or 16 per cent; Reo, 812, or 20.3 per cent.

The percentage also ran high among the truck manufacturers. At the Avery company, for example, 459 men or 16 per cent of the organization went into service; at the Federal Truck, sixty-five or about 10 per cent; Kelly-Springfield, 160 or 21.3 per cent; Indiana Truck, 110 or 25 per cent; Gramm-Bernstein, 146 or 20 per cent of entire force.

One Company Lost 51 Per Cent of Its Men

As noted, the percentages of men entering the service from the different plants varied very considerably, running all the way from more than 50 per cent down to 5 or 6 per cent. This depended very largely on whether or not the concerns claimed exemption for their men. The parts makers had about the same experience, percentages varying considerably.

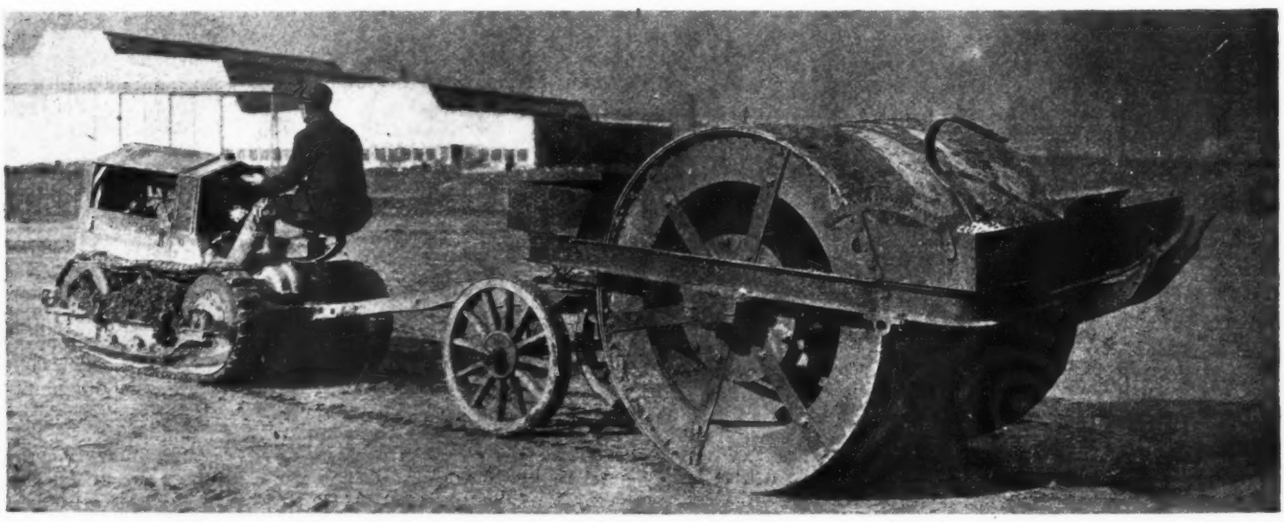
For instance, the Waukesha Motor Co. lost 51 per cent. of its force through enlistment or draft, while the Muncie Gear Works lost five men or about 3 per cent. The average is somewhere around 20 to 25 per cent. Continental, employing a large force of men, lost 1300 men through enlistment, this being about 21.6 per cent of the total employed and forming a fair average from which to base statistics.

The automotive industry contributed heavily from its executive officers to all branches of the service. Taking the office force, the percentages of those entering the service did not run so high, the average being somewhere around 12 per cent. The Willys-Overland Co. had about 175 of its office force in the service or about 18 per cent; Reo had about thirty or about 9 per cent; Haynes had eight or about 13 per cent.

Those entering the service from the offices of the commercial vehicle manufacturers ran somewhat higher in percentage, the average being about 20 per cent. The Lewis-Hall office force lost about 50 per cent through entering the service; Kelly-Springfield, fifteen or 25 per cent; United Motors, seven or 25 per cent; Gramm-Bernstein lost twenty-two from its office force or about 20 per cent of the total. These percentages are lower than the skilled and unskilled laborers, largely due to the exemption pleas entered by concerns for their executives, and also due to the predominating number of older men in the executive and office positions.

Parts Makers Released 20 Per Cent of Force

The parts makers averaged about the same as the truck manufacturers, 20 per cent being the approximate average. Probably as large a percentage as any in the parts making business is exemplified by the Empire Axle Co., which lost nine of its office force or about 75 per cent. The Sheldon Axle lost ten or about 10 per cent; Standard Parts, thirty-five or about 10 per cent; Warner Gear, fifteen or 10 per



Cleveland tractor pulling a road roller in preparing the flying field at the Glenn Martin plant at Cleveland

cent; the Grant-Lees lost 25 per cent; Muncie Gear, 25 per cent, so that, all in all, the average losses in the office staffs of the different companies was about 25 per cent.

The industry is gratified by the fact that many of its prominent members were selected for high civil and military positions. It is impossible to attempt to list the executives of automobile, truck and parts concerns who were commissioned and held high rank in the service. Practically every executive staff of the larger concerns in the business contributed its quota of majors, captains and lieutenants. These men entered the service and in many cases sacrificed large incomes in order to be of assistance to the government. Henry B. Joy, ex-president and director of the Packard Motor Car Co., was a colonel in the Signal Corps; J. G. Vincent, vice-president of engineering of the same company, was a lieutenant-colonel. H. L. Shepler, vice-president in charge of production at the Willys-Overland Co., was a major in the aircraft service. Howard E. Coffin, vice-president of the Hudson company, was chairman of the aircraft board and did much to frame the policy which was eventually developed in our aircraft service. Vice-President Alden of the Timken-Detroit Axle Co. became a colonel in the Ordnance Department and was in charge of the development of tanks. W. G. Wall of the National company became a lieutenant-colonel in the Ordnance Department and distinguished himself in the development of military tractors. This list could be made indefinitely long, telling of the contributions of the executive staffs of the different automobile factories of their men to important uniform and non-uniform branches of the service.

Executives on Patriotic Work

The important work done by executives of the automobile, truck and parts makers in helping the Liberty Loan and War Savings Stamp work cannot be overlooked. Many executives turned over a large percentage of their time to this work. As a typical example, J. D. Dort, president of the Dort Motor Car Co., may be mentioned. When war with Germany was declared, Mr. Dort turned his interests over to others and devoted his entire time to war work, becoming chairman of the Genesee County, Michigan, War Board, which exceeded its quota by $1,000,000 in voluntary subscriptions alone on the Fourth Liberty Loan.

There are many interesting sidelights in connection with what the different companies of the industry did and many fascinating human-interest stories. One of these is the rise of Edwin Denby, treasurer of the Denby Motor Truck Co., through the sheer force of personality. Mr. Denby entered the marines as a private and rose to a captain by the time the armistice was signed.

Spent $12,000,000 for New Buildings

The story of the Willys-Overland Co., which spent $12,000,000 for new buildings, equipment and for changing over old equipment in 19 months and 6 days in order to get into production, is noteworthy. John Willys went ahead and produced airplanes before he ever received an order for them, so sure was he that the government would need this product. Special machinery had to be made by the Overland company in order to produce the French 77-mm. gun carriage. There were over 1600 parts in this gun carriage, of which 146 are forgings, but by the time the armistice was signed the Overland company was putting these through at the rate of twenty-five a day. The manufacture and machining of 8-in. shells was another tremendous undertaking. As an example, every single shell manufactured had to be tested under a hydrostatic pressure of 8500 lb. per sq. in., and the shell had to withstand this or be rejected.

The utility of the type of internal combustion engine developed by the automotive industry proved itself in numerous ways. We are no longer surprised to hear of Cadillac eight-cylinder engines, which we at one time pictured as exclusively a passenger car proposition, actuating 2½-ton artillery or driving the winches for pulling down captive balloons. These and many other adaptations of well-known power plants were common in war service.

The White convoys were distinguished by being merited the Croix de Guerre, this being the first and only instance in French military history of a truck formation receiving this high honor. And yet all of the above is of necessity only a smattering of what was actually done; this country was only in the midst of diverting its entire automotive facilities to war work. Many factories were just converting themselves to their new lines when the armistice was signed and the contracts cancelled, allowing them to hurry back to their normal lines, and many are in the midst of the work of getting back to usual production at the present time.

Experimental Design and Testing of Airplane Ribs

(*Continued from page* 460)

been made on the Type "I" rib, as made in production. These tests were made with the load grading, as shown in Fig. 6, and the load grading as specified by the Army in sand loading of wings. These tests are not only for the standard rib, but for the rib in the section of the wing with the aileron cut out.

It will be noted that the weight of the various ribs started in at 15 oz. and ran as high as 20¼ oz. The average weights of ribs in production is 11½ oz.

The cost of manufacture of this rib as produced is much less than the standard type using veneer for the webs and cutting out various shaped portals.

All tests were made with certified glue, but later some ribs were built up with cold glue and apparently there was no difference in the results. But in production only certified hot glue is used.

The deflection in the table is given for each load of factor of safety of one, and is a convenient indication of rigidity. It is seen that the final type of rib held its original shape the best and that the aerodynamic characteristics will not be appreciably changed in normal flight. In the table on page 458 the deflection is shown for the center section. Space hardly permits of any more detail information on this.

Fig. 7 shows the contour of the rib and the dotted outline shows rib No. 31 with a load 8 times normal load. The total deflection is 23/64 in., or .043 in. deflection for normal load.

Station.	Readings from Load Grading Curve.	Actual Weight.	Difference in Weight.
1.....	61.80	64.2	2.4
2.....	65.80	66.8	1.0
3.....	63.40	64.2	0.8
4.....	57.79	58.5	0.51
5.....	52.95	53.5	0.55
6.....	47.35	47.0	0.35
7.....	41.35	39.5	1.85
8.....	36.52	34.0	2.52
9.....	32.50	31.0	1.50
10.....	29.28	28.5	0.78
11.....	27.28	26.8	0.48
12.....	25.27	26.0	0.73
13.....	23.67	24.0	0.33
14.....	22.06	22.0	0.06
15.....	20.06	20.0	0.06
16.....	17.25	17.2	0.05
17.....	14.84	14.2	0.64
18.....	10.83	11.0	0.17
19.....	7.62	7.3	0.32
20.....	2.51	3.0	0.49
	660.13	658.5	15.59

Average difference in weight, 0.780 lb.
Tabulated loadings as shown in Fig 6.

The Carburetion Temperature of Oil Mixtures

By C. A. Norman
Professor Ohio State University

THE present article gives a method of determining the temperature necessary to keep in a permanent state of vaporization any oil fraction contained in a carburized mixture. It gives curves applicable especially to the fractions of kerosene and derives the temperature necessary to form a permanent vapor mixture of kerosene and air. The knowledge of this temperature is of very great practical importance. If carburetion at a lower temperature is attempted, then partial condensation will most likely result; hence very incomplete combustion, high fuel consumption, dilution of the lubricating oil in the crankcase, carbon formation on the spark plugs and cylinder walls, unequal firing, etc.—all troubles too well known in kerosene engine practice. If the temperature is much exceeded then avoidable knocking may appear; likewise dissociation of the fuel with carbon even in the inlet passages; finally reduction of power. The point of perfect carburization ought then to be known.

Kerosene is a mixture of fractions with widely varying boiling points. A leading company has communicated to the author the following as a typical composition of kerosene:

	Deg. Fahr.
Boiling starts at	292
10 per cent off at	369
20 per cent off at	386
30 per cent off at	400
40 per cent off at	415
50 per cent off at	422
60 per cent off at	441
70 per cent off at	458
80 per cent off at	476
90 per cent off at	496
98 per cent off at	554

It is seen that nearly 10 per cent of the kerosene under atmospheric pressure boils off above 500 deg. Fahr. and 2 per cent above 550 deg. Fahr. It is tolerably safe to assume that no noticeable fractions boil above 600 deg. Fahr. Now, when these fractions occur in a kerosene air mixture their boiling points correspond, not to the total pressure of the mixture, but to the partial pressure of the fractions in the mixture. Thus, to aid in the distillation of lubricating oil, quantities of steam are blown into the still. Say that the pressure in the still is 15 lb., and that we blow in enough steam to maintain a pressure of 8 lb. of steam alone. Then the pressure of the oil distillate is only 7 lb., and its boiling point lowered to correspond to 7 lb. pressure instead of 15 lb.

The ratio of the partial pressures P_1 and P_2 of the gases occurring in a mixture in weights G_1 and G_2 is

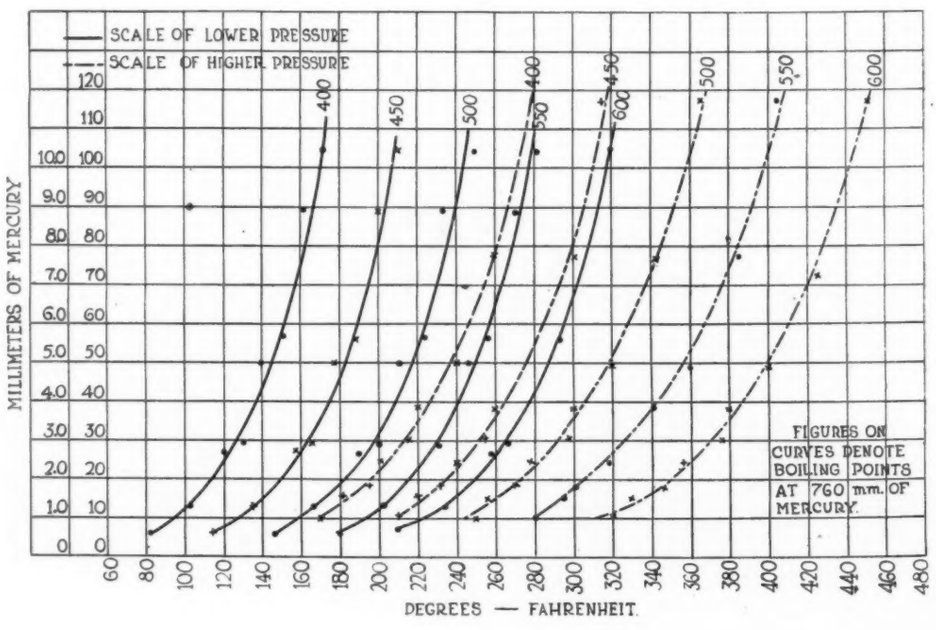
$$\frac{P_1}{P_2} = \frac{G_1 R_1}{G_2 R_2}$$

Here R_1 and R_2 are the "gas constants" of the mixtures.

The gas constant for any gas or vapor is very nearly equal to 1540 divided by the molecular weight of the gas. Thus for oxygen, O_2, the molecular weight is $2 \times 16 = 32$, and the gas constant, $1540 \div 32 = 48$; for nitrogen N_2 the molecular weight is $2 \times 14 = 28$ and the gas constant $1540 \div 28 = 55$; while for air a mixture of N and O with average molecular weight = 29.95. The gas constant is $1540 \div 28.95 = 53.2$.

In order to estimate the partial pressure of kerosene fractions in kerosene-air mixtures we have to find their gas constants with the aid of the molecular weights. These molecular weights can be figured directly from the chemical formula for the fraction. These formulas vary from kerosene to kerosene; but for most practical purposes we may assume the kerosene fractions to be either simple paraffins or naphthenes; in this country the former. The boiling points, molecular weights and gas constants are given in the table on page 491.

It is found that for highest power development it is often necessary to have a somewhat over-rich mixture. For complete combustion 1 lb. of kerosene requires about



Curves showing vapor tensions of paraffins derived by means of Ramsay's and Young's law from those of Octan and Dekan

15 lb. of air. Suppose we wish to be sure of the perfect evaporation of a mixture containing 1 lb. of kerosene to 13 lb. of air.

In the kerosene-air mixture listed in the table, only 2 per cent will at atmospheric pressure boil above 554 deg. Fahr. Let us, for the sake of safety, however, assume a kerosene with 10 per cent boiling at 600 deg. Fahr. In the mixture we would have 0.1 lb. of this fraction, 0.9 lb. of other kerosene and 13 lb. of air. The gas constant of air is 53.2; of kerosene we can assume it to be on an average 8.5.

For the whole mixture it is with sufficient accuracy

$$\frac{13 \times 53.2 + 1 \times 8.5}{14} = 50$$

For the heaviest fraction we shall, for the sake of safety, assume the gas constant rather high than low, say 6.5.

The pressure of the mixture will not exceed 14.7 lb. The partial pressure of the fraction is very low. Such low pressures are more conveniently expressed in millimeters of mercury, the unit usually employed in chemical works; 14.7 lb. correspond to 760 mm. of mercury.

We find the pressure of the heaviest fraction certainly not greater than

$$P = \frac{0.1 \times 6.5 + 760}{14 \times 50} = 0.7 \text{ mm.}$$

The drawing contains a set of curves showing the vapor pressure of various kerosene fractions for varying temperatures. Read from the vertical scale to the horizontal scale, it represents the boiling points, or perfect vaporization temperatures, of various fractions under various pressures. The full-line curves refer to the scale of lower pressures; the dotted curves, to the scale for higher pressures. We find that a fraction boiling at 600 deg. Fahr. at 760 mm. of mercury boils at about 210 deg. at 0.7 mm.

In other words, if the mixture has a temperature of 210 deg. or higher, the heaviest fraction will most decidedly be above its boiling point and no condensation will ensue. In a leaner mixture than the one here assumed the partial pressure of the fuel will be lower, the necessary vaporization temperature also lower. Since the lighter fractions occur in greater quantities, it might be advisable to check up what the average vaporization point for the kerosene will be.

We find

$$P = \frac{1 \times 8.5 \times 760}{14 + 50} = 9.2 \text{ mm.}$$

Taking the average boiling point to be 450 deg. at 760 mm., we find that this corresponds to a vaporization temperature of about 205 deg. Fahr. at 9.2 mm.

There is then no reason to doubt that almost any kerosene will give a permanently vaporized mixture at temperatures betwen 200 and 220 deg. Fahr.

It is very interesting to note that an unusually able experimenter in the field of kerosene carbureters, in private conversation with the writer, gave 220 deg. as the temperature in the intake manifold, at which his device worked most satisfactorily—giving abundant power without knock. Strange to say, at a temperature of around 180 deg. he found much less power with considerable knock.

It should be noted that the temperature of vaporization is not the temperature of the air before mixing. The evaporation of the kerosene consumes heat. The amount of this heat at reduced pressure is not accurately known, but will probably be around 250 B.t.u. per pound of kerosene, or about 20 B.t.u. per pound of air in a rich mixture. This corresponds to a cooling of the air amounting to about 80 deg. Fahr.

Name.	Formula.	Boil. Pt. deg. Fahr.	Molar Wt.	Gas Cnst.
Pentan	$C_5 H_{12}$	100	72	21.4
Hexan	$C_6 H_{14}$	160	86	17.9
Heptan	$C_7 H_{16}$	208	100	15.4
Octan	$C_8 H_{18}$	257	114	13.5
Nonan	$C_9 H_{20}$	302	128	12.0
Dekan	$C_{10} H_{22}$	344	142	10.85
Undekan	$C_{11} H_{24}$	384	156	9.85
Dodekan	$C_{12} H_{6}$	418	170	9.05
Tridekan	$C_{13} H_{28}$	454	184	8.35
Tetvadekan	$C_{14} H_{30}$	485	198	7.75
Pentadekan	$C_{15} H_{32}$	519	212	7.25
Hexadekan	$C_{16} H_{34}$	549	226	6.80
Heptadekan	$C_{17} H_{36}$	578	240	6.40
Octadekan	$C_{18} H_{38}$	605	254	6.05
Nonadekan	$C_{19} H_{40}$	626	268	5.73

For perfect vaporization the air before mixing should then have a temperature around 300 deg. Fahr.

For a present-day gasoline with 10 per cent boiling above 400 deg. Fahr. at 760 mm. the computations carried out in the foregoing lead to a vaporization temperature of around 100 deg. Fahr. and an air temperature of, say, 160 deg. Fahr. A cold engine and a cold hood should therefore certainly not be expected to constitute ideal conditions for this fuel.

The curves have been derived from experimental curves for Octan and Dekan by means of Ramsay's and Young's law. This law states that for the same pressure the absolute boiling temperatures of two related chemical substances stand to each other in a fixed ratio. Thus, if Dekan at 760 mm. boils at 312 deg. Fahr. = 772 deg. Fahr. abs., and at 25 mm. boils at 140 deg. Fahr. = 600 deg. Fahr. abs., then a fraction boiling at 500 deg., at atmospheric pressure, will at 25 mm. boil at

$$\frac{(500 + 460)}{772} \times 600 = 746$$

deg. Fahr. abs. = 746 = 460 = 286 deg. Fahr.

With the aid of this law we can exterpolate the curves to any desired extent.

Suppose, for instance, we have a gasoline mixture which vaporizes completely at zero Fahrenheit = 460 deg. Fahr. abs. The partial pressure of the gasoline in the mixture may be 10 mm. What would be the average boiling point of this mixture at atmospheric pressure? We notice that the 400 deg. fraction under 10 mm. pressure boils at 170 deg. Fahr. = 630 deg. Fahr. abs. Consequently the gasoline at issue would at atmospheric pressure show an average boiling point of

$$\frac{460}{630}(400 + 460) - 460 = 165 \text{ deg. Fahr.}$$

In other words, an aviation gasoline vaporizing completely at zero degrees Fahrenheit boils considerably below the boiling point of water; yet does not, on the whole, need to be such an extremely volatile product.

The writer was led to the foregoing investigation through a conversation with Mr. F. W. Howe, chief engineer on motor trucks to the International Harvester Corp. To Mr. Howe the potential value of the data furnished had long been apparent.

It is to be noted that all above temperatures referred to carburetion by perfect vaporization. Carburetion by mechanical suspension resulting in a so-called fog mixture may be possible at lower temperatures.

AUTOMOTIVE INDUSTRIES
The Automobile

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Executives Who Understand Labor Needed

IT is a little surprising that we have not insisted upon the understanding of human principles and impulses in our industrial executives to a greater degree. We are prone to put men into executive positions, primarily, because they understand the products and the processes of manufacture when the principal problem which confronts them is the human problem.

This tendency to minimize the study of human affairs has resulted in the neglect of this study by most industrial executives to such a degree that each development of industrial disturbances finds us almost as far away from any idea of solution as before.

Fortunately, there is a distinct improvement in this direction. We no longer speak of labor as some abstract problem, not related to living and not concerned with social and political environment. We have thrown away the idea that labor interests us merely for so much time and so much physical accomplishment.

The rest must come. To successfully manage an industrial establishment in the future will demand a consideration of human affairs, deep enough to give a reasonable understanding and sympathetic enough to breed intelligent tolerance.

The struggles for self-expression and a measure of control in the management of his own destinies have impelled the man to turn his attention from political to industrial development and the recognition of this by the industrial executive must bring the study of causes and effects which is required for solution.

Wasted Money

HUNDREDS of thousands of shell blanks are lying in the yards of automobile and other factories that were working on shell contracts when the armistice was signed. The Government ordered in many instances that the work on these shells be stopped on Jan. 31. The purpose is to take the blanks to the Government arsenals and finish up the work later, perhaps under a different administration.

The question that naturally springs up immediately is: Why not finish up the shells in the plants where the blanks are stored? The forging companies finished their work and turned the blanks over to the plants where they were to have been machined. These plants were busy on machining work and in numberless cases had hundreds of workmen employed on the job when they had to lay off when the Government stepped in and stopped the work.

It is going to cost the Government additional money to move the blanks to the arsenals and there to set up the machinery and heat-treating apparatus to take care of the work. The plants could have efficiently finished the work on the spot and painted the shells and turned them over for storage. The men who were employed on this work could have been kept employed and not turned loose and it would have given the factories an opportunity to have gradually absorbed this labor into their normal lines.

The machinery was all set to do the work and to clear away these orders in fast time. Why stop them in the middle of the work? The machinery had to be taken down and stored and there it lies in these plants waiting for Government adjustment, while the blanks lie out in the factory yards, awaiting the time when the Government will move them away to the arsenal. This requires twice the transportation work, twice the manual handling of the forging and many times the work in setting up machinery instead of using what was already set up and running on regular production. It is indeed difficult to understand why the run was not carried through to the exhaustion of the blanks as long as the shells are going to be made anyway.

Keep Fuel in Mind

NOW that the excitement of the show season is passing like a wave over the country, and attention is swinging rapidly back to peace time channels, do not let us forget some of the big things that were brought to our attention during the past few weeks.

The fuel situation is a prominent case in point. It has always been difficult for the experimental department of a factory to get money appropriations when the production and sales departments were clamoring for funds, but it would be well for every factory in the business to set aside a sum of money for the research men to use in their studies of the fuel situation.

Do not let the movement for a fuel section of the Society of Automotive Engineers fail to go through to its logical conclusion. This is a matter which requires constant thought and study in order that the development on the engineering side of the business shall keep pace with what is sure to occur in the refining industry. We know from what unbiased experts told us at the S. A. E. meeting in New York that a continuance of the present fuel uses in the present manner and with the increased requirements due to trucks and tractors that the price is sure to advance materially.

The industry will be hampered by increases in the price of fuel, therefore the industry should do its part in forestalling these either by aiding in the development of engines or devices that will utilize other and more plentiful fuels. The money to carry on the necessary research work can readily be contributed by the industry either through its own companies, through the S. A. E. or both. There is no more vital problem confronting us to-day, and we would be failing in ordinary common sense if we did not continually study the fuel prospects of 1921 and 1922. If a reminder is needed, remember that the *curve of crude consumption has crossed the curve of crude production.*

Disposition of Railroads Important to Industry

THE statements made in and out of Congress in regard to the disposition of the railroads and the plans which have been brought up by the late Directer General and others who have given the railroad situation some study from the point of view of the necessities of the railroads or the political effect of certain methods of handling them, calls to our attention the fact that very little has been said about the effect of the disposition of the railroad problem upon the country's industries and economic development.

Perhaps this is to some extent the fault of the business men in this country who paid no attention to the railroad question in the past except to appear in Washington at regular intervals to fight against an increase in rate. Little discussion has occurred on this subject in the Chamber of Commerce and in the meetings of other business bodies which would indicate that the business men of this country fail to realize the intimate relation between the railroad problem and the possibilities of their own business.

Manufacturers in the automotive field drawing raw materials from many sources, depending upon transportation by railroads to a very large degree for the continuance of their supplies and for the operations of this tremendous industry, should be thoroughly concerned with the proposed methods of dealing with the railroad situation and should make it their business through their associations to see that their influence is exerted in favor of such a method of solving the future operation of the railroads as will assure the proper extension of railroad facilities in this country, the adequate increase of terminal and distributing facilities to keep pace with the growing traffic on the railroads and the adequate up-keep of the trucks and equipment so that the service upon the present lines will be maintained at its maximum.

The failure of the business men of this country to exert their influence for the proper extension of transportation facilities of all kinds in the past should only emphasize the lesson which has been pointed out by the war necessities, that is, that the growth of industry depends upon adequate extension and up-keep of transportation facilities to such a degree that no group of manufacturers can afford to have the matter decided at a peace conference or by political adjustment or without respect to the industrial necessities of the case.

The time is ripe for organized bodies to concentrate on the problem and possibly for the appointment of committees representing industry to investigate the matter and present the industrial view of the railroad question to Washington.

Will Road Racing Be Revived?

WILL racing be revived? There can be no question but that racing, properly and scientifically restricted racing, over highways for long distance provides the motor car engineer and builder with a means of testing for which there is no adequate substitute. It can be made, by suitable regulations, the supreme test of efficiency rather than a mere contest of speed. It is expensive and, therefore, requires commercial competition to influence the manufacturer to take it up. Perhaps that competition will be supplied by foreign makers who may find it desirable to revive racing in order to build up prestige for their products; we cannot say, but it seems to be at least a possibility.

Latest News of the

New Models and Strong Representation of Parts Makers at K. C. Tractor Show

Automobile Practice Adapted to Tractor Design—New Models Emphasize Tendency—Thorough Enclosure of Working Parts Popular—Parts Makers Show Realization of Tractor Importance by Complete Exhibits

KANSAS CITY, Feb. 26 (Special Telegram).—Clean-cut lines and thorough enclosure of working parts are strongly emphasized at the Fourth National Tractor show, which is running here this week. Most of the new models emphasize tendency and some of them are worthy additions to the few makes that have already worked toward this end.

A case in question is the new Twin City three-plow tractor which is undoubtedly one of the best jobs yet produced. It is a well balanced design, clean-cut in appearance and exceptionally accessible. The use of a 16-valve engine is an example of how automobile practice can be adapted to tractor design. The new four-wheel-drive Heinz is the simplest type of this drive yet produced, and its development will be watched with interest.

A large part of the show is devoted to implements designed exclusively for tractor use, and these are improved designs and stronger than those heretofore marketed for tractors. It is now recognized that more strength must be put into a tractor plow than a horse plow if satisfactory service is to be given. Other types of specially designed tractor implements are on hand in greater numbers than ever before, including disk harrows, corn planters, silo fillers, cultivators and threshing machines.

Enclosed Drive Through Axle

The show is not only the greatest tractor show ever held, but containing, as it does, exhibits of all the important tractor and tractor implement makers, as well as a most imposing array of makers of such parts as engines, transmission systems, ignition apparatus, carbureters, radiators, castings, forgings, stampings, etc., it ranks as one of the greatest shows of automotive apparatus ever had.

The general character of the show is high grade in every respect. It is staged in a one-story frame $40,000 building, erected in the last three weeks for the purpose and which will be torn down as soon as the show is over. In the mechanical line there is a good deal that is new, though most of the novelties are quite divergent in character, so that it is difficult to discover distinct new tendencies.

One exception must be made to this general statement, namely, that there is a recognizable tendency toward enclosed drive through the axle. This practice, almost unknown four years ago, is to-day found on a dozen tractor models and is constantly gaining ground.

Front Axles Clumsy

From an inspection of models exhibited it is evident there are two schools of design, which may be referred to as the strap iron school and the drop forging and casting school.

The first builds all the structural parts of rectangular bar steel and angle iron while the latter uses drop forgings or castings. The difference begins at the front axle, where one school uses a built-up construction and the other a drop forged one-piece axle. We had occasion last year to remark on the great number of clumsily designed front axles which were excusably only in experimental jobs. There has been little change since. In explanation it should be stated that during the war it was impossible to get dies made for forgings and since the armistice there has not been sufficient time to allow makers to redesign. On the whole, It may be said with assurance that front axles are a part in which there is much room for improvement.

There is one factor which is retarding progress along sound engineering lines, and that is that many farmers do not appreciate good engineering. A farmer examining one of the best tractors exhibited, remarked that there was too much fine machinery in the tractor. He recognized the quality of construction, but it actually repelled him. Some day he will probably learn that fine machinery is not synonymous with delicate machinery and that a machine carefully designed with respect to stress imposed on its parts is sure to give greater satisfaction than one bearing marks of crudeness all over.

Increased Use of Springs

Springs are used to an increased extent, especially in front. Some employ semi-elliptics while others use coils on the steering knuckle pins. While the spring action may be made the same in both, it is evidently accompanied by more sliding motions where coils are used and where the machine has frequently to work in a cloud of dust the sliding motion should be reduced to minimum. Spring suspension at the front end can be readily obtained and as it eliminates some of the short period vibrations which make it so difficult to hold parts together in a tractor it will become a universal feature in time.

Little Change in Frames

There is little change in frames, but more designers are dispensing with a separate frame. In this way weight is saved and in some cases increases the accessibility of important parts.

Several new engines are exhibited, including the Walker overhead camshaft type, and entirely new type in the tractor field. It tends toward clean-cut design as all moving parts are enclosed. There is a considerable number of excellent tractor engines on the market and any concern about to enter the field as an assembler will have no difficulty in securing an engine suitable to requirements.

No departures in practice are noticed in carburetion and ignition, but the size of temperature regulators and indicators is making headway. This is not surprising when it is remembered that the successful burning of kerosene depends so much on proper engine temperatures.

Lengthwise Worm Drive Gaining

In transmissions and final drives there is a wide variety of layouts. Some accomplish the necessary gear reduction which for conventional engine speeds and drive-wheel diameters range between 40 and 50, in a single step, while others use as many as five distinct steps for gear reduction. It is not necessary to state that, other things being equal, the fewer the reduction steps the better, as each transmission of power from one shaft to another is accompanied by loss. The all-spur type of drive continues with several adherents, though most newer designs have the engine lengthwise. Worm-drive is gaining. There is a notable tendency to use the worm in first gear reduction and spur gears or chain drive for final reduction. This overcomes the difficulty of enormous tooth pressures and thrust loads encountered where the worm is used for final drive.

There are a few striking departures from established practice. The Heinz is one, which is a four-wheel-drive type in which the complication ordinarily asso-

(*Continued on page* 506)

Automotive Industries

Citroen Post-War Car Out

Has First French Post-War Car—$1,450 to $1,960—Plans 100 Daily

PARIS, Feb. 12—André Citroen will produce the first really post-war automobiles in France. It will be on the market in about one month. His production will be 100 per day from the middle of April. Although a few other French manufacturers have cars almost ready for delivery, nobody else has got down to a production basis, nor has any other firm announced prices.

Citroen is specializing on a single model 10 hp., four-cylinder block engine of 65 x 100 bore and stroke. It has forced feed lubrication, high tension ignition, a three-speed gear box and final drive by Citroen herring-bone gears; left-hand steering is fitted; Michelin steel disk wheels have been adopted; wheel base of this car is either 98 in. or 110 in.; track is 46 in.; weight of the car is 1450 lb., completely equipped; speed on the level is 40 m.p.h., and gas consumption is 31 miles per American gallon. The car is equipped with electric lighting and starting.

As a three-seater, this car will be put on the market at $1,450. Price with four-seater body is $1,590, with inside steering body the price is $1,600 and as a town coupé, $1,960. The same chassis is also built with an express delivery body carrying a load of 550 lb., the price of this being $1,480.

Before the war, Citroen was engaged in the production of gears for automobiles. Before the signing of the armistice he was producing 50,000 shells per day. As the factory has never before built automobiles, the change over from a war to a peace basis is exceedingly rapid. None of the old French automobile firms have been able to get back to automobile production in such a short time. In addition to automobiles, Citroen will produce bicycles and sewing machines.

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Columbia Six to Be Exhibited at Lyons Fair

DETROIT, Feb. 24—The Columbia Motors Co. will exhibit one of its model sixes at the fair in Lyons, France. The car was shipped a month ago.

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Briscoe Has Space at Lyons

JACKSON, MICH., Feb. 19—The Briscoe Motors Corp. will exhibit one of its cars at the Lyons Fair through Messrs. Dutrieu & Co., Paris.

Provisions in the Revenue Bill

Three per cent tax on motor trucks and trailers.
Five per cent tax on passenger cars.
Five per cent tax on tires, parts, accessories and inner tubes.
Ten per cent tax on shows.
Ten dollars annual tax on taxicabs seating 7 or less.
Twenty dollars annual tax on taxicabs carrying more than 7 persons.
Three per cent of transport cost for freight by truck in competition with rail or water.
Five per cent of transport cost for express by truck or passenger car in competition with rail or water.
Eight per cent of transport fee for carrying passengers by truck, passenger car or motorcycle in competition with rail or water.

Signs New Revenue Bill

Law in Force at Once—Will Tax Trucks, Passenger Cars and Accessories

WASHINGTON, Feb. 24—President Wilson to-day signed the new Revenue Bill.

The law becomes effective beginning Feb. 25. The provisions, which were published in detail in a recent issue of AUTOMOTIVE INDUSTRIES, include a tax of 3 per cent on motor trucks, trailers and the equipment, including tires, tubes and other parts; 5 per cent on passenger cars and all other automobiles, including equipment, excepting on tractors, which are not taxed, and 5 per cent on tires, inner tubes, parts and accessories made for automobiles and sold to any person other than an automobile manufacturer. A tax of 1 cent for each 10 cents is assessed on tickets of admission and supplies to automobile or parts shows held during the year.

The tax of 3 per cent on motor truck haulage where it competes with rail or water transportation of freight remains in the bill, and there is a tax of 1 cent paid for motor truck express where it

(*Continued on page* 501)

Stage for Makers' Aero Exhibit Set

Eighty-Five Exhibits Scheduled—Cabinet Officers to Be Present

NEW YORK, Feb. 25—Preparations for the Aeronautical Exposition of the Manufacturers' Aircraft Association are completed and arrangements have been made for displays by 85 exhibitors in Madison Square Garden and the 69th Regiment Armory for the two weeks beginning March 1. The semi-official character of the show has brought about the co-operation of the war, naval, post-office and interior departments, and the program as arranged designates Monday, March 3, as Army Day, when Secretary of War Baker will deliver an address. It is expected that Secretary Burleson of the Postoffice Department, Secretary Daniels of the Navy Department and Secretary Lane of the Interior Department will also be present.

The largest airplane on display is the F5L U. S. Navy flying boat, capable of carrying fifty people. The letter F stands for Felixstowe, the British Naval Construction Station. The figure 5 designates the series number and the letter L indicates that the plane is equipped with the Liberty engine. This ship is an adaptation from a British flying boat. During the war it is used as a submarine chaser, has an upper wing span of 103 ft. 9 in. and a lower wing span of 74 ft. 4 in. Its length over all is 49 ft. 4 in. It stands 8 ft. 9 in. from the ground to the top wing. The chord is 8 ft. and the gap 8 ft. 10 in. Although its gross weight is 13,000 lb. it has a maximum speed of 87 m.p.h. and can climb to 2625 ft. in 10 min. It is equipped with two Liberty engines.

That the exposition will have a distinctly international character is assured by the exhibit of the American built adapted Handley-Page, the Caproni triplane, Spad scout, Breguet, a captured German Fokker D-7 and other foreign planes.

The Glenn L. Martin bombing plane, a biplane engined with two Liberty engines, will be displayed. Both wings are of the same span, 71 ft. 5 in. The length overall is 44 ft. 10 in. The height is 14 ft. 7 in. It has an inner surface of 1070 sq. ft. Its gross load is 9663 lb. In speed it outstrips all of its huge rivals, being officially credited with 118 m.p.h. and a climb of 10,000 ft. in twenty-one months. Another type of British machine will be the SE5, which at one

time during the war created consternation among the Germans.

Another feature of the Italian section will be the SVA Gabriel D'Annunzio, the Italian poet, used in his propaganda trips in Vienna.

There will also be a Nieuport Breguet and a LaPere. The latter plane was built in this country by the Packard company at Detroit.

The balloon exhibit will take up a large portion of the air space in Madison Square Garden.

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List of Exhibitors at Aeronautical Exposition March 1 to 15, 1919

Empire Art Metal Co., College Point, L. I.
Arthur Johnson Mfg. Co., New York.
Dodge Mfg. Co., Mishawaka, Ind.
Valentine & Company, New York.
Zenith Carbureter Co., Detroit.
Wellington, Sears & Co., New York.
John A. Roebling's Sons Co., Trenton, N. J.
Eastman Kodak Co., Rochester, N. Y.
Motor Compressor Co., Newark, N. J.
Cold Light Mfg. Co., New York.
Livingston Radiator Corp., New York.
American Balsa Co., New York.
Jones Motrola Company, New York.
Champion Ignition Co., Flint, Mich.
Dayton Eng. Lab. Co., Dayton.
Ajax Auto & Sheet Metal Co., New York.
Stone Propeller Co., Dayton, Ohio.
Aerial Age, New York.
Splitdorf Electrical Co., New York.
National Cash Register Co., Dayton.
Jamestown Propeller Co., Jamestown, N. Y.
American Propeller & Mfg. Co., Balt., Md.
Hartzell Walnut Propeller Co., Piqua, Ohio.
Dayton Wire Wheel Co., Dayton.
Lunkenheimer Co., Cincinnati.
General Ordnance Company, Groton, Conn.
Society of Automobile Engineers, New York.
Gardner Moffat Company, Inc., New York.
Torrington Company, Torrington, Conn.
Simms Magneto Co., East Orange, N. J.
Triplex Safety Glass Corp., Mount Vernon, N. Y.
Radium Dial Co., Pittsburgh.
American Bosch Magneto Co., New York.
Detroit Accessories Corp., Detroit.
Sterling Engine Co., Buffalo.
Perry Austen Mfg. Co., Grasmere, S. I.
Dayton-Wright Airplane Co., Dayton.
Curtiss Aeroplane & Motor Corp., Buffalo.
L. W. F. Engineering Corp., College Point, L. I.
Wright-Martin Aircraft Corp., New Brunswick, N. J.
Aeromarine Plane & Motor Co., New York.
Thomas Morse Aircraft Corp., Ithaca, N. Y.
Burgess Company, Marblehead, Mass.
Gallaudet Aircraft Corp., East Greenwich, R. I
B. F. Sturtevant Company, Hyde Park, Boston, Mass.
Packard Motor Car Company, Detroit, Mich.
Lawrence Aero Engine Corp., New York.
Gio Ansaldo & Co., New York.
Goodyear Tire & Rubber Co., Akron.
Cantilever Aero Co., New York.
L. Sperry Aircraft Co., Farmingdale, L. I.
Boeing Aeroplane Co., Seattle.
Glenn Martin Co., Cleveland.
Stewart Hartshorn Co., New York.
Matthews Bros. Mfg. Co., Milwaukee.
Budd Wheel Corp., Philadelphia.
A. G Spalding & Bros., Nassau St., New York.
Titeflex Metal Hose Corp., Newark, N. J.
Doehler Die Casting Co., Brooklyn.
Norma Co. of America, New York.
Stromberg Motor Devices Co., New York.
United Aircraft Engineering Corp., New York.
Anderson Forge & Machine Co., Detroit.
Wyman-Gordon Co., Worcester, Mass.
Standard Parts Co., Cleveland.
Mossberg Co., Attleboro, Mass.
Aero Science Club, New York.
Dural Rubber Corp., Flemington, N. J.
Aeronautical Society of America, New York
Rich Tool Co., Chicago.
Hess-Bright Mfg. Co., Philadelphia.
Liberty Starter Corp., New York.
Ericsson Mfg. Co , Buffalo, N. Y.
B. F. Goodrich Co., Akron.
Champion Spark Plug, Toledo.
U. S. Light & Heat Co., Niagara Falls.
Standard Turnbuckle Co., New York.
A. J. Meyer Mfg. Co., West Hoboken, N. J.
Junior Plattsburg, Inc., New York.
Class Journal Co., New York.
Edison Electric Appliance Co. Inc., New York

France Will Need 40,000 Tractors

More Than 8,000,000 Acres to Be Cultivated Mechanically—Only 3033 Tractors in France

By W. F. Bradley

PARIS, Feb. 15—France can absorb 40,000 agricultural tractors during the next four or five years, according to an estimate made by Representative Compère-Morel of the Agricultural Commission. This estimate, which appears to be a very moderate one, is based as follows:

In the period immediately preceding the war, France had 44,500,000 acres of land under cultivation for grain, potatoes and beets. It is estimated that one-quarter of this area, or 8,600,000 acres, will be cultivated by mechanical means within a very short time. These 8,600,000 acres will have to be plowed in 100 days, on an average; but two-thirds of this land, which is made use of for autumn sowing, will have to be plowed in a period of about sixty days. This gives, therefore, 5,500,000 acres of land to be worked in sixty days, or 98,000 acres per day. It is estimated that a tractor will plow 2 2/5 acres per day. This is probably a rather liberal estimate. On this basis, therefore, 40,000 tractors are required.

A short time ago, figures were issued showing that France possesses only about 800 agricultural tractors. These figures were incomplete. The total number of tractors in service at the end of December, 1918, was 3,033, composed as follows: One thousand eight hundred and thirty-five belonging to French farmers, 898 belonging to the Government and loaned to farmers on special terms, 300 tractors in Government's reserve. Of the 898 practically all were of American origin, for only forty-seven had been bought from French manufacturers, as follows: Filtz, 20; Doizy, 12; De Dion-Bouton, 3; Tourand-Latil, 10, and Julien, 2.

In the opinion of Representative Compère-Morel, the immediate requirements of France will have to be met by gasoline tractors. But the greatest development, he considers, will be with electrically propelled tractors, the electric current being generated either from water power or from wind mills. At the present time all tractors are either gasoline or steam driven.

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Big Merger Rumor

DETROIT, Feb. 24—The automotive world awaits with interest the announcement expected any day of a big merger of automobile, truck and tractor companies into an organization patterned after General Motors. Norval A. Hawkins, former sales manager of the Ford Motor Co., is busy upon the project but has made no statement regarding his plans. He is said to be backed by Kuhn-Loeb Co., a New York banking house.

Many Detroit companies have been mentioned as possible units in the proposed corporation. It is said to-day that the following five concerns may form the nucleus of the Hawkins organization. These companies are the Commerce Truck Co., the Signal Truck Co., Grant Motor Car Corp., the Doble-Detroit Steam Motor Co. and the Lincoln Motor Co. The Saxon Motor Car Co. and the Hupp Motor Car Corp. have also been mentioned, but officials of these two concerns emphatically deny the rumor.

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NEW YORK, Feb. 25—Kuhn-Loeb Co. deny that any plans for financing or organizing a merger of automobile interests under Norval Hawkins is contemplated. The bankers state that they have heard the rumors for several weeks, but disclaim any knowledge of them other than as current gossip.

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Record Flight from Washington to New York

WASHINGTON, Feb. 24—Lt. Frank H. Harmon, pilot of Bolling Field, Anacostia, made a record flight from Washington to New York in a La Pere plane, landing at Hazelhurst, N. Y., 85 minutes after his take-off at Bolling Field, on Feb. 19. In this flight a straight distance of 269 miles was covered, making the average speed 189.9 m.p.h.

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Agreement Reached on Informal Contracts Bill

WASHINGTON, Feb. 26—After a long disagreement by the Senate and House conferees over the bill to validate informal war contracts a compromise was reached to-day that gives promise of early action and passage of the law. The deadlock was over the payment of contracts for metals and minerals ordered and production of which had been stimulated by the war contracts. The bulk of the contracts validated by the bill total over $2,000,000,000 and include business with the automotive industry of more than $300,000,000.

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Air Regulations Under Department of Commerce

WASHINGTON, Feb. 26—President Wilson to-day recommended that aerial licensing and regulation be placed under the Department of Commerce as suggested by the National Advisory Committee for Aeronautics, and asked Congress for the necessary legislation. Secretaries Baker, Daniels and Redfield also indorsed the plan.

The legislation would give the Department of Commerce authority to issue licenses for civilian flyers and includes an appropriation of $250,000. Without some sort of regulation and control of licenses, it was pointed out, there would be many fatalities caused by amateur flyers, and in addition airplanes might be used for smuggling from Mexico or Cuba.

Organizing Federal Highway Committee

All Bodies Interested in Road Contruction to Be Fully Represented

WASHINGTON, Feb. 21—As a result of the meeting of various organizations interested in highway construction in Chicago recently the National Highway Committee is being organized to represent practically every organization for the construction of roads and those interested in this work and to secure intensive industrial support for road construction.

S. M. Williams, president of the Highways Industries Association, has appointed the State Highway Commissioners and Engineers and various prominent men throughout the country to the committee, giving each State representation of three or more and in each case selecting men known for their present interest and activity in highway development. Total membership of the committee will be about 300 and will include the presidents of various prominent national organizations such as the American Road Builders' Association, National Automobile Dealers' Association, etc.

Although the Federal Highway Committee is not yet completed, it is already assuming important proportions. Following is the organization as formed to date:

Federal Highway Committee

W. T. White, Cleveland.
F. A. Seiberling, Akron.
R. D. Chapin, Detroit.
A. G. Batchelder, Washington, D. C.
Coleman du Pont, Wilmington, Del.
F. A. W. Vesper, St. Louis.
A. H. Blanchard, New York.
Chas. H. Davis, Cambridge, Mass.
Alfred Reeves, New York, and others.

National Road Organizations

Highway Industries Assn., Washington, D. C.
National Highway Assn., Washington, D. C.
American Road Builders' Assn., New York.

Transcontinental Road Organizations

Lincoln Highway Assn., Detroit.
Dixie Highway Assn., Chattanooga, Tenn.
Jefferson Highway Assn., St. Joseph, Mo.
National Old Trails Assn., Kansas City, Mo.
Pacific States Defense League, Seattle, and others.

National Trade Organizations

National Automobile Dealers' Assn., St. Louis, Mo.
National Real Estate Boards, Washington, D. C.
National Retail Hardware Assn., Argos, Ind., and others.

State Trade Organizations

Penna., New Jersey and Delaware Wholesale Growers Assn., Philadelphia.
New England Hardware Dealers' Assn. Boston.
Illinois Valley Manufacturers' Club, La Salle, Ill., and others.

State Good Road Organizations

Ohio Good Road Federation, Columbus.
Michigan Good Road Federation, Hastings, Mich.
New York State Road Builders' Assn., Albany, N. Y., and others.

Commercial Organizations

Chamber of Commerce, Philadelphia.
Chamber of Commerce, St. Louis.
Chamber of Commerce, San Francisco, and others.

Rotary Clubs

Ohio State Assn. of Rotary Clubs, Columbus.
Michigan, State Assn. of Rotary Clubs, Grand Rapids.
San Francisco Rotary Club, San Francisco.
New York Rotary Club, New York City, and others.

Travellers Protective Associations

Post L, T. P. A., New Orleans.
Post E, T. P. A., Charleston, S. C.
Post C, T. P. A., Reading, Pa., and others.

United Commercial Travelers

Council No. 16, U. C. T., Philadelphia.
Council No. 75, U. C. T., Cincinnati.
Council No. 165, U. C. T., Brooklyn, N. Y.

FEDERAL HIGHWAY COMMITTEE

Advisory — Direction — Finance

Vice-Chairman — Chairman — Vice-Chairman

Executive Committee

Highways Industries Association

Advisory and Co-operative Organization for Federal Highway Legislation

National Road Organizations
Transcontinental Road Organizations
National Trade Organizations
State Road Organizations
State Trade Organizations
State Grange Organizations
Commercial Clubs
Rotary Clubs
Traveling Men's Protective Association—Local Posts
United Commercial Travelers' Association—Local Councils

Half Billion Planned to Build Highways

WASHINGTON, Feb. 24 — Expenditures for highway work in the United States this year are likely to amount to a half billion dollars, according to the Bureau of Public Roads. The bureau estimates the expenditures for roads and bridges at $385,000,000, or $110,000,000 more than the average expenditures for 1916 and 1917. This does not include additional Federal funds which will be available if the amendment to the Post Office Appropriation bill, making $50,000,000 immediately available and $75,000,000 more on July 1, is enacted into law.

Estimated work under control of the state highway departments includes $45,000,000 for the construction of 5,000 miles of road now under contract, $30,000,000 for 4,000 miles of construction ready for contract, $100,000,000 for 16,000 miles of contemplated construction, and $60,000,000 for maintenance of 200,000 miles. Expenditures of counties, and local districts are estimated at $100,000,000 for the construction of 150,000 miles and $50,000,000 for maintenance of 100,000 miles.

Federal Highway Plan Outlined in Bill

Provides for Commission of Five Members and National System of Main Highways

WASHINGTON, Feb. 25—The bill to create a Federal highway commission, to establish a National highway system and promote road construction, introduced by Congressman Townsend, provides for a commission of five members, to be appointed by the President. Provisions are made for a complete system of highways and post roads, and specifies that no less than two main trunk line roads are to be in each State. The commissioners will receive $10,000 yearly salary. They will have complete control of highways with power to determine types of construction and improvement, repair and maintenance.

The War Department is authorized to deliver to the commission any vehicles needed for use in the construction and control of highways, without charge, and in addition, any road machinery and equipment requisitioned.

Road building along economic, scientific lines, will be given a tremendous impetus the country over by the passage of the bill, in the opinion of Roy D. Chapin, former chairman of the Highways Transport Committee of the Council of National Defense and chairman of the Highways Committee of the National Automobile Chamber of Commerce.

"The United States is on the eve of a revolutionary epoch in highways transportation," said Mr. Chapin. "Hundreds of millions of dollars are available now for construction throughout the country and scarcely a day passes that we do not hear of some new movement looking toward better highways.

"The Townsend bill provides a sure means for such a program and it is safe to say that all who understand the importance of efficient highways transportation will be solidly in favor of its adoption by Congress at the earliest possible moment."

No State will benefit from expenditures of Federal money for highway construction until it approves this bill. The bill was read to the House and referred to the Committee on Post Offices and Post Roads. There is little chance that it will pass during this session. Following is the complete bill:

That there is hereby created a Federal highway commission, and to provide a connected system of main highways adequate to sustain the demands of interstate commerce, to provide adequate post roads for the transportation of the United States mails and parcel post, and to provide for the common defense and promote the general welfare of the people of the United States there is hereby authorized to be established, constructed, and maintained a system of highways, hereinafter referred to as the national highway system, to comprise not less than two main trunk-line roads in each State, and joining the national highway system in the adjacent States and countries. The term "commission" used in this act shall mean the Federal highway commission, hereinafter referred to as commission; a highway, within the meaning of this act, shall be deemed to include the

(*Continued on page* 507)

Elysee-Palace Hotel for Auto Sales

Citroen Buys Hotel for Sales Building—Avenue Champs Elysees Auto Row

PARIS, Feb. 10—The Elysée-Palace Hotel, the biggest and the most luxurious of the hotels of Paris, situated in the Champs Elysées, recognized as the finest avenue in the world, has been purchased by André Citroën, and it is declared that it will be used as an automobile showroom and business headquarters.

This hotel belonged to the Compagnie Internationale des Wagons-Lits, and Citroën has secured it by the purchase of a predominant number of shares in this concern. The public is at a loss to understand how Citroën can make use of such a huge building as automobile showrooms and office. The hotel must have not less than 1000 rooms, including several handsome halls. It is at present occupied by the Quartermaster and Signal Corps of the American Army, but, being much too big for these services, they will move out at an early date.

Citroën is only just entering the automobile field, and the car he is producing is of a popular type, sold at a very moderate price. It is not the class of cars usually associated with the luxurious Champs Elysées showrooms.

The Avenue des Champs Elysées is becoming more and more commercialized by the automobile industry. Originally the trade was located in the Avenue de la Grande-Armée, which is a continuation of the Champs Elysées. It is on the north side of the Etoile Monument. Now manufacturers and dealers are coming to the more luxurious south side of the monument. In addition to Citroën, those who have secured or are preparing to secure showrooms in the Champs Elysées are: Fiat, Rolls-Royce, Panhard & Levassor, Renault, Delaunay-Belleville, Lorraine-Dietrich, Braiser, Sizaire-Berwick, Bellanger and Berliet. The German Mercedes showrooms in this avenue have been used by a war charity organization for the past two years, and probably will be taken by some French automobile firm as soon as normal conditions are restored.

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Committee to Standardize Petroleum Specifications Asks State Co-operation

WASHINGTON, Feb. 24—In appealing to the Governors of the various States for co-operation in standardizing petroleum specifications for the entire country, letters have been sent to the Governor of each State containing memorandum as to the laws for gasoline inspection in each State along with the bulletins issued by the Committee on Standardization of Petroleum Specifications. This committee has been investigating the subject for months, and a series of standards are gradually being developed which are put out from time to time in bulletin form.

EXPORTS OF PASSENGER AUTOMOBILES IN 1914 AND 1918

Country	Twelve months Ended Dec. 31, 1918 No.	Value	Twelve months Ended June 30, 1914 No.	Value
Canada	8,543	$7,141,405	4,377	$5,445,052
Australia	3,826	3,271,317	3,099	2,615,896
Japan	2,699	2,877,693	96	100,995
Mexico	1,915	1,539,266	155	239,166
Chile	1,734	2,315,386	195	160,194
Cuba	1,780	2,638,001	297	254,428
Philippine Is.	1,690	1,462,571	614	697,175
Argentina	1,628	1,673,137	940	963,586
New Zealand	1,418	1,228,864	1,065	974,708
Uruguay	1,351	799,787	183	167,269
Brit. S. Africa	1,205	1,070,570	1,618	1,437,883
D'ch E. Ind's.	1,260	1,567,766	290	208,722
Brazil	1,108	856,374	299	264,992
France	1,003	1,134,818	1,427	919,060
China	874	896,728	144	143,619
Spain	808	1,042,788	83	64,758
Germany	...	.....	1,411	1,040,787
England	398	997,342	6,992	5,615,487
Russia (Eu'pe)	10	8,325	926	898,458
Other co'tries.	3,686	3,756,256	4,094	3,180,728

EXPORTS OF MOTOR TRUCKS IN 1914 AND 1918

Country	Twelve months Ended Dec. 31, 1918 No.	Value	Twelve months Ended June 30, 1914 No.	Value
France	3,356	$12,920,029	2	$5,070
England	2,080	5,999,541	203	189,099
Canada	1,596	2,035,464	247	474,724
Japan	605	895,125	1	900
Cuba	557	1,109,368	19	33,500
Mexico	397	524,035	12	17,509
Chile	154	239,621	2	10,743
D'ch E. Ind's	154	335,536	7	14,232
Philippine Is.	152	205,519	38	64,805
Norway	108	320,574	2	3,852
Scotland	182	667,413	..	.....
Peru	100	246.393	3	5,301
Other co'tries	864	1,336,334	248	361,876
	10,308	$26,814.952	784	$1,181,611

According to the committee, the variety of standards prevailing in different localities tends to raise the price of gasoline and other petroleum products for the consumer. Common standards, it is believed, would also improve quality. In this communication to the State Governors it is also pointed out that although the Fuel Administration will cease to function after peace is declared, the Committee on Standardization of Petroleum Specifications will continue for six months after that time.

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U. S. May Now Ship to Finland

WASHINGTON, Feb. 25—Arrangements have been made by the War Trade Board whereby both export shipments and import shipments from Finland can be resumed. All shipments for export to Finland must be governed by the import certificate issued by the Inter-Allied Trade Committee at Helsingfors. Exporters should apply for licenses to the Bureau of Exports, Washington, but before filing applications must have advice from the prospective importer in Finland that a certificate has been issued by the Inter-Allied Trade Committee approving the proposed consignment.

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St. Louis Show Huge Success

ST. LOUIS, Feb. 22—Judging by the attendance, the twelfth annual auto show being staged here at the Exhibit Building is a remarkable success. All past records have been broken. Facilities had been arranged to handle 16,000 people at the doors and the great crowds caused a call for special police details. More than 20,000 people clamored for admission.

Change in Post-War Exports Expected

Truck Exports to Decrease, Passenger Car Exports to Grow

NEW YORK, Feb. 24—That a radical change may be expected in the exportation of passenger cars and trucks with the ending of the war is the view of the National Automobile Chamber of Commerce. During the war, it is pointed out, yearly exports of cars more than doubled over the pre-war shipments, due to the inability of European makers to meet export demands. A much more pronounced effect, however, was noticeable in motor truck exports, which averaged 13,300 per year with an average value of $42,500,000 as against 888, valued at $1,459 for the fiscal year ended June 30, 1913 and 1914.

As the military demands of Europe greatly increased the truck shipments, it is now anticipated that there will be a drop that will bring truck shipments near their former proportion to passenger car exports.

A report of motor vehicle exports to all countries during 1918 shows that 10,308 trucks, valued at $26,814,952, and 36,936 passenger automobiles, valued at $36,278,292, were shipped abroad last year. In the fiscal year ended June 30, 1914, the last 12 months' period before the war, we exported only 784 trucks, worth $1,181,611, and 28,306 passenger automobiles, worth $25,392,963.

Analysis of the exports in 1918, as compared with 1914, shows that while the exports of passenger cars to England, France, Germany, Russia and British South Africa decreased notably and increased only slightly in Australia, they doubled to Canada, increased 28-fold to Japan, 12-fold to Mexico, nearly 9-fold to Chile and Spain, 6-fold to Cuba and China, more than 7-fold to Uruguay, more than quadrupled to the Dutch East Indies and almost doubled to Argentina.

Of the truck exports last year, on the other hand, more than half of the 10,308 went to England and France alone, while in 1914 less than one-third of the 784 shipped abroad went to these two.

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M. A. M. A. Closes Washington Office

WASHINGTON, Feb. 24—The Motor and Accessory Manufacturers' Association office here was closed to-day, and R. M. McConnell, who has been in charge of it, is returning to Detroit. The office was a temporary one used chiefly to keep in touch with the Congressional action in the matter of the "Bill to Pay Informal Contracts."

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Ontario to Build Roads

TORONTO, Feb. 24—The Ontario Government will spend $5,000,000 on highway construction this year. This means that with federal aid $8,333,333 will be expended for roads in Ontario this year.

British Aero Mfrs. Society Permanent

All Makers Are Members of Society of British Aircraft Constructors

LONDON, Feb. 2—One of the war organizations which will take its place as a permanent organization of peace days is the Society of British Aircraft Constructors formed in the early months of 1916, when aircraft manufacture was taking on the stature of an industry, and when it was apparent that all makers engaged in different phases of the work must co-operate to the fullest extent to give the necessary output of aircraft.

To-day every maker of aircraft in Great Britain is a member of this society. The list includes not only the makers of planes and engines, but those producing parts, dope, materials, steel in all forms, textiles, etc. There is no rivalry between those firms who before the war represented the aircraft industry on the one hand, and those new firms born of the war, that have become the greatest producers of aircraft.

There are two grades of membership: Poll members, made up of manufacturers of planes and engines; and associate members, representing makers of parts, materials, etc. Steel and aluminum makers also have membership in the society.

In the plan of organization the Committee of Management, composed of 14 members, manages the society. The membership is divided into sections according to manufacturing interests. Thus there is the dope section, the engine section, metallurgical section, etc. One section, known as Aerial Transport, has as its specific task all matters relating to aerial navigation. The government consults this section whenever it wishes advice from the manufacturers.

So far it has been impossible for the society to take any action relating to cross licensing of patents, as the government took over all aircraft patents in the early days of the war and still controls them. It is not known what action regarding patents may be taken when government control is released, if it ever is released with reference to patents.

The society has left the entire work of aircraft standardization in all its ramifications to the British Engineering Standards Committee, which is the final authority on all work relating to standardization in the British Empire. No manufacturing specification becomes a standard until so designated by the B. E. S. C. All standards for all industries come under its control. The actual steps in arriving at different standards are largely carried out by the members of the industry concerned, but the approval of any specification as a standard must come through the B. E. S. C.

During the war the society had little to do with government contracts except to work for their uniformity, and if manufacturers had complaints with reference to them these reached the government through the channels of the society rather than by direct representation of the manufacturer concerned.

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French Racers for Indianapolis

PARIS, Feb. 21 (Special Cable. Delayed in Transit).—René Thomas, Albert Guyot and Bablot will race at Indianapolis on May 31.

Guyot drove one of the Sunbeams on the occasion of its first appearance in this country in 1913. The following year he came in third, driving a Delage, at Indianapolis. On his discharge, the result of wounds received, from the French Army, in which he saw active service as an airplane pilot, he entered into partnership with N. Causan and engaged in the profession of consulting engineer. The partner, who collaborated to produce successful car and boat engines for the Delage Co. and others, is particularly interested in racing and aviation development.

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Ready for S. A. E. Air Meeting

Will Discuss Commercial Future of Airplanes, Aircraft Radiators and Dirigibles

NEW YORK, Feb. 25—The program for the meetings of the Society of Automotive Engineers, to be held in conjunction with the Aeronautical Exposition on March 7, is practically complete, and will include afternoon and evening sessions with a dinner at 6.30 p. m. The meetings and dinner will be held at the Engineering Societies Building, 29 West Thirty-ninth Street.

The afternoon session will include a paper on the commercial future of airplanes from the engineering standpoint by C. H. Day, chief engineer of the Standard Aircraft Corp.; a paper on aircraft radiators by Archibald Black of the United States Navy and former chief engineer of the L. W. F. Engineering Co., and a paper on dirigibles by Ladislas d'Orsy, editor. Pictures will be used to illustrate the discussions.

The dinner, which will be given at 6.30, is particularly intended to afford the members to become acquainted with one another and to allow for informal discussions on aviation. The evening session following the dinner will include addresses by officers of the United States Army and Navy and members of the automotive industry, whose names cannot yet be announced, as the evening program is not definitely completed.

The S. A. E. is also conducting an exhibit at the Aircraft Exposition on standards.

It is expected that there will be a large attendance at these sessions, when C. H. Manly, the newly elected president, will preside.

Auto Export Chiefs Will Meet

To Discuss All Pertinent Questions of Foreign Trade—Addresses Already Scheduled

NEW YORK, Feb. 25—A convention of automobile export managers will be held in the city March 7 under the auspices of the National Automobile Chamber of Commerce. Foreign trade opportunities, foreign credits, service abroad, packing for foreign shipments and the effect of the revenue bill on exports will be among the many subjects discussed. The meeting is being held as a result of the numerous export problems now facing the industry, and because of the new and unparalleled foreign conditions which are so intricate that co-operative discussion and action are made necessary.

Addresses already scheduled for the convention include:

"Trade-Marks in Foreign Countries." By James L. Stuart, of Stuart & Perry.

"What Our New Ships Can Do for Exporters." By Ira Campbell, U. S. Shipping Board, Washington.

"Definite Things We Must Do to Advance Export Trade." By Roy S. McElwee, Assistant Chief, Bureau of Foreign and Domestic Commerce, Department of Commerce.

"How to Use the Webb-Pomerene Law Providing for Combination of Competitors for Export Selling." By Allen Walker, Mgr., Foreign Trade Dept., Guaranty Trust Co.

"Automobile Publicity in Foreign Lands." By Peter S. Steenstrup, Export Manager, General Motors Export Co.

"Straight Side Tires and Right Hand Drive for Foreign Markets." By D. B. Richardson, Export Manager, Studebaker Corporation.

"Financing Foreign Trade." By G. A. O'Reilly, Foreign Trade Representative, Irving National Bank.

The meeting will be at the direction of the Export Committee of the N. A. C. C., which includes J. Walter Drake, chairman, Hupp Motor Car Co.; H. M. Robins, Dodge Brothers; D. B. Richardson, Studebaker Corp.; B. S. Steenstrup, General Motors Corp.; J. Rathburn, White Co., and R. T. Williams, Willys-Overland Co.

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Mexican Oil Imports Increase

WASHINGTON, Feb. 24—Regardless of embargoes and other restrictions imposed by the Mexican Government, oil imports from there to the United States are steadily increasing, according to the Department of Commerce. During the period between July 1 and Jan. 13 last, crude oil imports from Mexico amounted to 1,060,615,650 gal. and refined to 26,744,049, valued in total at $15,500,000. This was a greater amount than the imports for the entire year 1917.

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Tax Mexican Parcel Post Imports

WASHINGTON, Feb. 22—The Mexican decree of Jan. 7 provides a special surtax of 15 per cent of the respective customs duties on all goods imported or exported by parcel post.

England Standardizes Steels

Institution of Automobile Engineers Evolving Complete Standards Program

LONDON, Feb. 4—With the signing of the armistice activities connected with the Institution of Automobile Engineers have taken on renewed interest. In the first days of war the institution's work was greatly hampered. In fact, it was throughout the war, but the organization was maintained, and a more or less depleted office force carried along.

A monthly schedule of meetings has been drafted and carried out. The attendance at the last two meetings was greater than at any previous meetings during the war. Meetings are held on the 5th of each month.

The program for the remainder of the winter and spring season follows: Feb. 5, "Efficient Invention," by Douglas Leechman, a leading patent attorney and agent; March 5, "Lubrication," by Capt. G. W. A. Brown of the Arrol-Johnston Co.; April 5, "Electric Vehicles," by Carl Opperman, who has been closely associated with electric vehicle matters for many years; May 5, "Diesel Engines," by J. Day of Mirrless, Bickert & Day, makers of Diesel engines. At the Jan. 5 meeting L. H. Pomeroy's address on "Valve-in-the-Head Engines" was heard by over 200 members and guests.

The war almost completely disrupted the standardization program of the institution, but since Nov. 11 the go-ahead has been given, and a comprehensive committee organization has been created and pushed into action.

Standardize 20 Automobile Steels

The 100 per cent turning of the automobile industry to electric lighting and starting has called for quick standardization decisions on all such apparatus. The work on battery standardization has just started. The holding of a preliminary meeting represents accomplishments to date. It is quite certain that plate dimensions will be standardized, and the desire is to work as closely with American standards as possible.

With electric starting motors outside dimensions are going to be standardized. The committee is under way in this work. No decisions with regard to electric generators have been made. The committee has not yet started work on this. A committee is working on carbureter flanges, but as yet it is not very active and little progress has been made.

The greatest standardization work accomplished to date is that on 20 different automobile steels. All of the research work on these has been done and the specifications decided upon as well as the physical tests each must meet. In this work the steel manufacturers co-operated to the fullest extent with the automobile engineers. In 11 months from the start of the work it was completed, and by that time ten of the standard steels were in production by the steel men. The specifications of these steels appeared in a recent issue of AUTOMOTIVE INDUSTRIES.

In tire standardization much work has been done, but as yet Great Britain has more standard sizes than the United States. The sentiment in the I. A. E. is to still further reduce the number of sizes and if possible adopt the same standards as in America. Standardization work on magnetos and spark plugs has been completed.

The final adoption of any standard does not rest with the I. A. E., but with the British Engineering Standards Committee, an organization for standardization which represents all British industries, and whose approval is necessary before any standard in any industry can be officially recorded.

The automobile industry works through the B. E. S. C. in all standardization. In fact, the preliminary work is all done by committees of the I. A. E. and other automobille organizations. There is what is known as the Technical Committee of the Motor Industry, which is composed of representatives of three leading industrial groups, namely, (a) the Institution of Automobile Engineers, (b) the Society of Motor Manufacturers and Traders, (c) the Association of British and Allied Manufacturers, (d) representatives of other concerned organizations. This Technical Committee does the preliminary investigating work on any standard, and presents its conclusions to the B. E. S. C., which takes action as seems best.

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Resumption of Trade with Bulgaria, Turkey and Black Sea Ports

WASHINGTON, Feb. 24—The War Trade Board has authorized trade and communication between this country and Bulgaria and the Turkish Empire, both in Europe and Asia Minor, subject to its rules and regulations. Russian Black Sea ports, Roumania and all ports on the Black Sea are now open to trade with the United States.

Applications will be considered for licenses to export and import all commodities to or from such territory.

The War Trade Board has received no official statement as to what the import regulations into this territory, if any, will be. Prospective exporters should therefore communicate with their customers abroad before making shipments, to comply with any import regulations that may be in effect.

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U. S. May Now Ship to British Guiana

WASHINGTON, Feb. 25—Proclamations which restricted the importation of motorcycles and side cars, motor cars, including spare parts, farm tractors and trucks into British Guiana from the United States, have been revoked, according to a consular report. This revocation removes all restrictions on imports that were enforced in British Guiana during the war.

New Line of Hinkley Heavy-Duty Engines

Truck and Tractor Types Built on Design Standards of Class B Army Model

DETROIT, Feb. 24—The Hinkley Motors Corp., Detroit, is now producing a line of truck and tractor engines built around the standards of design and workmanship employed in the construction of the class B government engine. These are known as the Hinkley class B. In addition, models HA and HAA are built along similar lines, and show the same characteristics with reference to appearance and performance.

The line is rated at 55 hp. at 1400 r.p.m.; 45 hp. at 1500 r.p.m. and 35 hp. at 2000 r.p.m. for the respective models, and the engines are respectively suitable for 4-6 ton, 3-4 ton and 1½-2½ ton trucks, or 4 plow, 2-3 plow and 1-2 plow tractors.

The class B military engine has been described frequently and the Hinkley class B is similar in all essential respects. It is a 4¾ x 6-in. job with block cast cylinders. Model HA is 4½ x 5½ in. and is constructed along similar lines to the class B. Model HAA is 3¾ x 5¼ and is also adapted for cylinders of 4 in. bore for the purpose of being used with a maximum load capacity truck of 2½ tons. Detailed specifications and illustrations will appear in an early issue of AUTOMOTIVE INDUSTRIES.

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New English Motorcycle

LONDON, Feb. 10—A motorcycle produced by the Sopwith Aviation Co., Ltd., which first made its appearance before the war, is now being put on the market. Because of the war, work on this machine, the A. B. C., was stopped, while the company centered its efforts on aviation design.

The frame of the new machine is suspended on long leaf springs, both fore and aft. In the rear the chain stays are pivoted on roller bearings. At each end the springs are rigidly clamped, giving the effect of the cantilever pattern. A horizontally opposed 3 hp. twin-cylinder engine sets across the frame and is bolted to an aluminum gearbox, giving four speeds controlled by a gate lever. The flywheel and clutch are also enclosed, the drive being taken care of through bevel pinions and a slow-running chain to the back wheel. An elastic coupling in the driving sprocket absorbs any snatch in the transmission.

A positive lubrication system supplies both the gear and the engine, the oil being contained in a common pump. The valves are in the cylinder heads, which are of cast iron, and detachable. The cylinders are turned with their cooling ribs from the solid steel billet. Pistons are of aluminum alloy. The connecting rods have roller bearings running on a hardened crankshaft.

Road Builders Hold Annual Convention

Proceedings Based on Principle That the Motor Truck's Needs Are Paramount

NEW YORK, Feb. 26—As this issue of AUTOMOTIVE INDUSTRIES goes to press, the sixteenth annual convention of the American Road Builders' Association is holding its daily sessions at the Hotel McAlpin.

Although the convention is far from its close, a number of fundamental principles have been laid down. First and foremost, the general consensus of opinion tends very strongly to the axiom that roads must be built with due regard to the strains and stresses imposed by heavy automotive traffic. It has been, and is being, emphasized in no uncertain way that the motor truck is the king of the road, and that it is imperative that not only main highways but connecting roads shall be so constructed as to be fully capable of standing up under intensive motor-propelled traffic.

Highway engineers who may have hitherto considered road problems on a horse and wagon basis are now obviously fully alive to the fact that mechanical road transport has arrived, and whether they may be advocates of bitumenized or brick surfaces or cement or macadam foundations they have adapted themselves to the new order in no half-hearted way and, without exception, have declared themselves staunch supporters of whatever type of highway is most suitable for the truck.

Evidence of the realization of the coming of the motor truck as the standard method of highway transport was given over and over again. For example, the Hon. Francis M. Hugo, Secretary of State for New York, stated that it was with a full realization of the importance of the motor truck that appropriations covering road construction for the present and future years were made and that, moreover, 90 per cent of the increase in 1918 registrations for the State of New York were accounted for by the increase in the number of commercial motor vehicles in service.

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National Tractor Demonstration for Wichita

KANSAS CITY, Feb. 27—The Demonstration Committee of the National Implement and Vehicle Association has decided on Wichita for the 1919 National Tractor Demonstration, to take place some time in July. No definite date has yet been fixed. Exhibitions for Walla Walla and Macon have also been given official sanction.

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Industrial Board for Price Readjustments

WASHINGTON, Feb. 27—The Industrial Board of the Department of Commerce has been formed, composed of representative men from industry, labor and the Government, who are being selected under the chairmanship of George N. Peek, formerly vice-chairman of the War Industries Board. They are to put into practical effect a program for the readjustment of prices for basic materials in such a fashion as to create a firm foundation on which the consumer can base his future purchases, and the producer can form necessary estimates. The Industrial Board has the assistance of the Council of National Defense.

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President Signs Tax Bill

(*Continued from page* 495)

competes with rail or water express and a tax of 8 per cent of the transportation fee for carrying of passengers by motor truck, passenger car or motorcycle when it is in competition with rail or water carriers.

There is no floor tax or tax on motor fuels in the new Revenue act signed by the President Monday nor is there direct tax on car users except that persons carrying on the business of operating or renting passenger automobiles for hire are taxed $10 annually for each automobile seating more than one or less than eight passengers, and $20 a year for automobiles seating more than seven.

The tax situation regarding the exporting of automobiles, tires, parts and accessories therefor, is changed, so that under the new law, all such articles "sold or leased for export and in due course exported," are not subject to the tax. This is in compliance with the Federal Constitutional provision against taxes on exports.

There are some complicated provisions in section 1312 of the new law to the effect that on contracts for the sale or lease of cars and parts, etc., made prior to the date when this new law was first discussed in Congress, the purchaser or lessee must reimburse the seller or lessor for the tax that the latter has to pay.

Those liable for the tax on automobiles, tires, parts and accessories, must make monthly returns under oath in duplicate, to the local collector of Internal Revenue and pay the taxes due to this collector without further notice. If the tax is not paid when due, there is added a penalty of 5 per cent together with interest at 1 per cent per month.

Although it will be obligatory to report outputs of cars, trucks and accessories for each month on the last day of the month, manufacturers are being granted a 30-day grace for the few days between Feb. 25 and March 1, and do not need to report their output for these several days until the last day of March, when the reports can be turned in with the statements of March outputs.

The tax on automobiles, tires, parts and accessories becomes due when the article is sold or leased. This means, in the case of sales, when the legal title passes from the buyer to the seller or when the article ceases to be the property of the seller and becomes the property of the buyer, and in case of a lease, the lease is effective generally when the lessee receives possession of the article. Therefore, all sales and leases by automobile manufacturers and accessory manufacturers made on and after Feb. 25 are subject to the tax rates of the new law. All sales and leases made prior to Feb. 25 are either tax free or subject to the old tax rate, as the case may be.

Tax for Trucks In Canada

Fear Multiple Taxation by Different Municipalities—Not on Own Business Use

MONTREAL, P. Q., Feb. 25 — An amendment to the Motor Vehicle act of the Province of Quebec gives municipalities power to tax commercial motor vehicles and horse-drawn vehicles and truck owners fear that the authorities may neglect to provide distinctly that an owner of a commercial motor vehicle be only taxed by one municipality. Owing to the fact that the saddling of this tax by municipality is entirely optional, a motor owner might own several commercial vehicles in an adjoining municipality which did not levy a tax, yet that owner might use the streets of Montreal or of another municipality far more than those of his own municipality and, therefore, it would be manifestly unfair that he should go absolutely untaxed. On the other hand, provided that all municipalities take advantage of this amendment the burden upon the owner of the vehicle would be very heavy if he were called upon to pay a tax in every municipality in which he operated. Owing to the fact that motor vehicles are designed to cover long distances and comparatively few of them operate within a single municipality, it is felt that if the scope of this amendment is not clearly and definitely outlined in its construction that this clause may lead to confusion and hardships.

The amendments that are to be made to the motor vehicle law to allow municipalities to levy a business tax on motor vehicles by the Legislature will not apply to those firms who use automobiles, whether they be trucks or light delivery vans, for their own business, unless they be cabmen or common carriers.

Firms who use motor vehicles for delivering orders, such as the big department stores, will not have to pay any municipal tax, but only their provincial license fee. Those who use their trucks for hire, such as cartage and express companies, will, however, come under the Act, and will be liable to a tax by the municipality within whose limits they have their place of business, and not be liable to a tax by any other municipality within whose limits they may travel in the course of their business.

There is nothing specified in the bill as to the amount of this tax, but this will probably be amended so as to ensure that municipalities shall not charge a business tax greater than that specified for a 4-wheeled wagon with two horses, which is $12 for general carriers.

Kelly-Springfield Gross Profits, $7,187,834

NEW YORK, Feb 21—Gross profits of the Kelly-Springfield Tire Co. for the year ended Dec. 31 amounted to $7,187,834, as against $4,323,955 for 1917, and the surplus after dividends were paid was $2,939,992, an increase of $1,486,407 over 1917. The general surplus of $9,197,858 is an increase of $3,492,226 over $5,705,632 in 1917.

The company's balance sheet for the past two years follows:

Assets

	1918	1917
Cash on hand	$1,392,729	$772,448
Accounts receivable	1,467,296	1,748,346
Inventories	5,945,417	3,760,161
Deferred charges	37,883	52,188
Liberty bonds	596,793	272,353
Common stock purchased for re-sale to employees	42,197	8,560
Plant, patents, etc.	9,665,677	8,781,775
Total	$19,147,995	$15,395,835

Liabilities

Preferred stock	$3,407,100	$3,409,300
Common stock	4,907,200	4,907,200
Liberty bonds payable	.....	231,185
Accounts payable	721,815	835,752
Preferred dividend	51,106	52,639
Accrued wages, taxes, etc.	158,486	78,960
Res. for profit sharing plan	88,148	.....
Fund for redemp. pref. stock	.....	75,164
Special surplus account	433,162	.....
Res. of redemption of inventories	183,118	.....
General surplus	9,197,858	5,705,633
Total	$19,147,995	$15,395,835

Jordan Dividends

CLEVELAND, Feb. 24—A dividend of $3.50 per share to stockholders of record Jan. 31 was declared at the meeting of the board of directors of the Jordan Motor Car Co. on Feb. 12. The total production for 1918 was about 300 cars less than 1917. The following officers were elected for the ensuing year: President, Edward S. Jordan; vice-president, T. E. Barton; secretary and treasurer, Paul Zens. Besides the officers, the directors include Russell S. Begg and P. H. Withington.

Dunlop Profits $3,250,000

LONDON, Feb. 12—A large increase in profits is reported by the Dunlop Rubber Co., which held its twentieth annual meeting yesterday. A gain of $1,057,000 over 1917 profits was made by the company last year, the profit being $3,250,000, compared with $2,175,000 in 1917. The profits for 1918 were stated to be the largest in the history of the company. The company did not include in this statement of profits a sum of approximately $1,625,000 which has been retained for development and as additional working capital in the rubber estates and subsidiary companies and for the special plant and buildings depreciations. Thus, the actual earnings for the year are brought up to $4,875,000.

The solid tire business showed a large increase, amounting to nearly 60 per cent. The company is now planning new additions to increase its production. The new works at Fort Dunlop are in the process of enlargement. Approximately $2,000,000 will be expended by next August on these additions and it is expected that the pneumatic tire production will as a result be increased doubly and the solid tire production about 50 per cent.

The retiring directors and auditors were re-elected and Sir Arthur de Cros, chairman and managing director, was elected for life as president. Alfred de Cros has been nominated as vice-president. Harvey du Cros, the founder and president of the company, died during the war.

Goodrich Sales Increase 41 Per Cent in 1918

AKRON, Feb. 24—Net sales of the B. F. Goodrich Co. for 1918 amounted to $123,470,188, an increase of $36,315,116 over the $87,155,072 sales in 1917. After deducting for bills payable, taxes, etc., a net profit of $15,637,115 remained, $5,092,437 more than for 1917. After dividends were taken off the surplus was $10,442,609, against $5,257,491 in 1917.

The balance sheet of Dec. 31 last, compared with that of 1917, shows:

Assets

	1918	1917
Real estate, etc.	$74,859,587	$76,381,661
Investments	5,206,363	4,410,002
Pref'd treasury stock	930,700	865,700
Inventories, accounts receivable, cash, etc.	59,795,520	63,499,294
Deferred charges	446,258	970,589
Total	$141,238,427	$146,127,246

Liabilities

Capital stock	$85,500,009	$86,400,000
Accts. payable	16,770,900	33,649,867
Reserve	3,847,540	2,300,000
Appropriation for redemption of pfd. stock	.....	3,600,000
Surplus	35,119,988	20,177,379
Contingent liabilities	501,117	655,768
	$141,238,427	$146,127,246

National Sales $2,880,757

INDIANAPOLIS, Feb. 24—Net sales of the National Motor Car & Vehicle Corp. totaled $2,880,757 last year, according to its report for 1918. After deducting $2,395,793 for cost of sales, gross profits of $484,964 remained. Operating expenses and reserve equalled $236,502, miscellaneous income $18,325, and gross income $266,787. Subtracting interest amounting to $63,178 and $65,000 for income and war taxes, the net income was $138,609.

Detroiters Organize New Foundry Co.

DETROIT, Feb. 21—The D. J. Ryan Foundry Co., of Ecorse, Mich., has been organized and purchased the property of the Ecores Foundry & Machine Co. The capacity of the plant will be doubled. The manufacture of motor castings is now going on at full speed. D. J. Ryan is president of the company. Other officers are: Vice-president, Louis J. Felton; secretary, R. J. Lamb, and treasurer, Chester A. Trathen.

Bower Bearing Co. Surplus $299,073.55

DETROIT, Feb. 24—The Bower Roller Bearing Co. reports a surplus of $229,073.55 on Jan. 1. The capital stock is $600,000.

Hayes Wheel Co.'s 1918 Sales Total $7,655,249

NEW YORK, Feb. 26—Government contracts, increased maintenance and depreciation costs, and a falling off in production as a result of these contracts, are reflected in the financial statement of the Hayes Wheel Co., Jackson, Mich., for 1918. Notwithstanding these conditions, sales amounted to $7,655,249 on a production of 2,006,405 wheels, compared with sales of 3,571,681 wheels in 1917, valued at $8,674,370.

The falling off in number of wheels produced in 1918 was due to the output being partly of escort wheels for the Government, costing six to seven times more per wheel than automobile wheels. Escort wheels were not made after December, 1918. The company is now back on a peace basis and its production for 1919 is scheduled for more than 4,000,000 wheels.

Net profits for 1918 were $314,502, giving an average of $454,714 for the last three years, or 6½ times the $70,000 total annual requirements for interest on the $1,000,000 first mortgage bond issue. The company has an accumulated surplus of $822,673 and this added to its capital stock of $1,500,000 gives it an invested capital of $2,322,673.

The financial statement for the past two years follows:

Assets

	1917	Jan. 31, 1919
Real estate, plant and equipment	$1,438,222	$1,429,794
Securities	26,000	26,000
Accounts receivable	786,254	602,162
Inventories	1,400,130	1,704,508
Liberty bonds and cash value of insurance	60,400	39,156
Cash	393,953	412,333
Deferred charges	11,105	99,153
Total	$4,116,064	$4,313,106

Liabilities

First mortgage 7 per cent sinking fund bonds	.....	$1,000,000
Accounts payable and accrued	$1,110,908	671,433
Reserve for income and excess profit tax	270,000	280,000
Capital stock	1,500,000	1,500,000
Contingent reserve	.....	39,000
Surplus	.....	822,673
Five-year notes	400,000	.....
Interests and taxes accrued	13,996	.....
Reserve for depreciation	179,820	.....
Profit and loss	641,340	.....
Total	$4,116,064	$4,313,106

	1916	1917	1918
Wheels produced	2,598,928	3,571,681	2,006,405
Sales	$4,846,615	$8,674,370	$7,655,249
Profits	$609,498	$1,019,753	$950,532
Maintenance and depreciation	68,370	231,741	356,030
Balance	$541,128	$788,012	$594,502
Income and excess profits taxes	9,500	270,000	280,000
Net profits	$531,628	$518,012	$314,502
Interest and discount	60,338	37,327	63,062
Balance for stock	$471,290	$480,685	$251,440
Dividends	95,000	165,000	90,000
Surplus	$376,290	$315,685	$161,440

White Dividends

White Motor Co., Cleveland, regular quarterly dividend, $1 per share, payable March 31 to stockholders of record March 15.

Current News of Factories

Notes of New Plants—Old Ones Enlarged

Fire Wrecks Wilson Body Plant

DETROIT, Feb. 22 — The five-story brick assembly plant of the C. R. Wilson Body Co. burned to the ground Friday night. The loss, estimated at between $400,000 and $500,000, is covered by insurance.

Production will not be greatly handicapped. About 400 men are made idle by the blaze, but arrangements are being made to transfer them to the other plants of the company here and at Bay City. Assembly work will be shifted to other building units and the big plant will be operating normally again in a week or ten days.

—

Dorris Car Up $250

ST. LOUIS, Feb. 24—The Dorris Motor Car Co. has raised the price of its touring car from $3,500 to $3,750, to become effective March 1.

—

Moon Getting Back to Car Production

ST. LOUIS, Feb. 24—The Moon Motor Car Co. will resume production of automobiles March 15. Owing to the fact that it was engaged in shell work during the war, returning to motor cars was somewhat delayed. The new buildings, erected especially for shell work, will be equipped for motor car production.

—

Will Make 15,000 Hupps

DETROIT, Feb. 25—The Hupp Motor Car Corp. will produce 15,000 cars in 1919. This is an increase of 5500 cars over last year. During the last half of January this company ran up its production to forty cars daily, and further increase is contemplated.

—

Dorris Adds 3½-Ton Truck

ST. LOUIS, Feb. 22—The Dorris Motor Car Co. has added to its line a 3½-ton truck, styled model K-7, to sell for $3,800. The company's 2-ton vehicle sells for $2,985.

—

Allen on 1919 Production

FOSTORIA, O., Feb. 22—The Allen Motor Co. is getting into 1919 production and its schedule calls for the production of between 4000 and 5000 cars this year. With exception of refinements, the 1919 car differs only slightly from the standard 1918 model.

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Johns-Manville Distributes 20 Per cent Bonus

NEW YORK, Feb. 21—The H. W. Johns-Manville Co. will distribute to all its salaried employees who were in continuous service for the full year, 1918, 20 per cent on the salaries paid them during that year. The company also did this for 1917. The extra compensation for 1918 will cost approximately $1,000,000.

—

2000 Clydes This Year

CLYDE, OHIO, Feb. 24—The Clyde Cars Co. plans to build 2000 trucks in 1919, which is double the 1918 output.

Moline-Knight Will Not Cut Price

MOLINE, ILL., Feb. 21 — Moline-Knight dealers are being notified by the Root & Van Dervoort Engineering Co., makers of the car, that there will be no price decrease in the Moline-Knight during the present year. As an assurance that the present schedule will be continued, dealers are guaranteed refunds for their customers for the amount of any reduction that might be made before Jan. 1, 1920.

—

Moline Addition

MOLINE, ILL., Feb. 22—To take care of increased production, the Moline Plow Co. is adding a new 160 x 28 building to furnish more convenient shipping facilities. It will be utilized for storing the finished machines prior to shipment.

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Willys Export Co. Formed

TOLEDO, Feb. 22 — The John N. Willys Export Co. has been incorporated in Delaware with capital of $100,000 by John N. Willys and associates to engage in export work.

—

Miller Rubber Yearly Sales

AKRON, O., Feb. 24—The board of directors of the Miller Rubber Co. was re-elected and all other officials reappointed at the annual meeting of the company. Charles E. Wetzell was chosen assistant secretary. Inability of the auditor to submit a report made it necessary to omit the annual statement. It was stated, however, that the gross sales were over $16,000,000 in 1918, a 45 per cent increase over 1917.

—

Lee Tire Earns $30,000 More Than 1917

NEW YORK, Feb. 22—The Lee Rubber & Tire Corp. showed earnings of $250,000 for 1918, as compared with $220,000 for 1917, after all necessary deductions were made. Sales for January, 1919, are about 30 per cent larger than for the same month last year. Although the company's financial position is understood to be good, there is no prospect of a disbursement to the stockholders for some time.

—

Paige-Detroit Ahead of Schedule

DETROIT, Feb. 22—The Paige-Detroit Motor Car Co. is producing between 40 and 45 cars daily, which is a greater production than the January and February schedules called for. By March production will exceed 65 cars. This company, when the armistice was signed, was working 90 per cent capacity on war contracts, totaling approximately $15,000,000. About 60 per cent of these contracts were completed.

Cadillac Producing 60 Cars Daily

DETROIT, Feb. 24—The Cadillac Motor Car Co. has run its production up to 60 cars daily, and anticipates producing between 90 and 100 shortly. The 1919 production schedule will probably equal that of 1918, which called for 18,000 cars.

—

Standard Tool Co. Getting Back to Normal

DETROIT, Feb. 22—The Standard Tool & Mfg. Co. is getting back to peacetime production and is now running at 75 per cent capacity. This concern was engaged at its full capacity on war work up to the signing of the armistice.

—

9000 Commerce Trucks 1919 Output

DETROIT, Feb. 24—The Commerce Motor Car Co., makers of Commerce trucks, will build 9000 machines this year, according to their proposed production schedule. The company is turning out 20 cars daily, but will increase production 50 per cent within 30 days.

—

Appersons Ready for Delivery May 1

KOKOMO, Feb. 22—Owing to the post-war material situation, it was impossible to have the standard Apperson models ready in time for the various automobile shows. Deliveries on the open-body models are assured for May 1, but the enclosed models in both seven- and four-passenger types will not be ready till early fall.

—

Canadian Ford Guarantees Price

DETROIT, Feb. 24—The Ford Motor Co. of Canada, Ltd., states that 1919 will bring no change in the price of Ford cars. The prices follow:

Runabout	$660
Touring Car	690
Coupe	875
Sedan	1075
Standard Chassis	625
One Ton Truck Chassis	750

—

Dividends Declared by Goodyear

Goodyear Tire & Rubber Co., Cleveland, regular quarterly dividend, 3 per cent, common stock, payable March 1 to stockholders of record Feb. 15.

—

$1,800,000 American Bosch Notes Sold

NEW YORK, Feb. 22—The $1,800,000 American Bosch Magneto Corp. 7 per cent gold notes have all been sold.

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Inter-State to Complete 15-20 Per Cent of War Orders

MUNCIE, IND., Feb. 24—The Inter-State Motor Co. will be required to complete 15 to 20 per cent of the Government order, and manufacturing will be continued with this end in view. At the same time the engineering and experimental departments are going ahead with modifications and improvements in the Model T chassis which has a four-cylinder engine. The service department has been re-established.

Rickenbacker Back in Civil Life

NEW YORK, Feb. 25—Capt. Ed. V. Rickenbacker has received his honorable discharge from the army and has returned to this city. Although the American ace of aces has received attractive offers from motion picture producers and from publishers he has not yet decided what business he will engage in.

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Samuel E. Ryder, for a number of years in the employ of the Motometer Co., Long Island City, is now affiliated with the Detroit branch of the company opened recently.

—

W. B. Fowell has been appointed sales manager of the Stan-Par Axle division of the Standard Parts Co.

—

Frank M. Lee, manager of the Milwaukee branch of the Fisk Rubber Co., New York, has resigned after a term of continuous service of twenty-five years. He will go to California for a rest of several months.

—

Thomas W. Brickley has succeeded F. L. Warner as manager of the Milwaukee office of the Central Electric Co., Chicago.

—

G. M. Rymarczick, until recently supervising senior inspector of the magneto section of the Bureau of Aircraft Production, is now connected with the Simms Magneto Co., East Orange, N. J., as production engineer.

—

John B. Giovanoli, formerly with the Willys-Overland Co., has become tool superintendent of the Fuller & Sons Mfg. Co., Kalamazoo, Mich.

—

Captain A. E. Callanan has been appointed general purchasing agent of the Cleveland Tractor Co. He was formerly in charge of production of de Haviland battle planes at the Dayton-Wright Co., Dayton.

—

J. H. Hardig, formerly advertising manager of the Remy Electric Co., has been appointed assistant advertising manager of the motor equipment division of the United Motors Corp., Detroit.

—

E. H. Walker, for eight years Detroit district manager for the Vanadium-Alloys Steel Co., Pittsburgh, has resigned to become secretary-treasurer of the Michigan Metal Supply Co., Detroit.

—

R. J. Snowhook, for three years connected with the Willys-Overland Co., Toledo, Ohio, has joined the advertising department of the Nash Motors Co., Kenosha, Wis.

—

Lieut.-Com. Benjamin Briscoe of the Briscoe Motor Co., Jackson, Mich., has returned from Europe, where he was in charge of navy airplanes, air bases and supply depots.

Men of the Industry

Changes in Personnel and Position

Frank Jay Heads Stanley Motor Carriage

NEWTON, MASS., Feb. 25—Frank Jay was elected president and general manager of the Stanley Motor Carriage Co. at the annual meeting of the company held on Feb. 20.

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Albert L. Jones, for twenty years with the White Co., is in charge of the assembling branch of the Fulton Motor Truck Co., San Antonio, Tex.

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C. M. Strieby, former advertising and sales manager of the Smith Motor Truck Corp., Chicago, has been appointed advertising manager of the Fulton Motor Truck Co., Farmingdale, L. I. He was formerly connected with the Maxwell Motor Car Co. and with the Studebaker Corp.

—

Capt. Albert G. Waddell has returned to civil life and resumed his duties as advertising manager of the Chevrolet Motor Co., Oakland, Cal.

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H. S. Quick has been appointed manager of the Chicago office of Robert H. Hassler, Inc., which has recently been opened at 2007 Michigan Avenue.

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R. G. Ames has joined the Black & Decker Mfg. Co., Baltimore, as branch manager in charge of the Chicago office. For the past ten years he was with Edward A. Cassidy Co., New York.

—

Lieut. F. M. Young, formerly in the aviation service, has returned from overseas and is now sales engineer with the Perfex Radiator Co., Racine, Wis.

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Detroit S. A. E. Officers Nominated

DETROIT, Feb. 26—W. A. Brush, of the Brush Engineering Association, has been nominated to head the Detroit section of the Society of Automotive Engineers for the season of 1919-1920, to succeed J. Edward Schipper of the Class Journal Co. E. G. Gunn, carriage engineer of the Packard Motor Car Co., has been nominated for the vice-chairmanship; E. W. Seaholm, Cadillac Motor Car Co., treasurer, and Ralph H. Sherry, metallurgist General Motors Co., secretary. The nominating committee consisted of D. McCall White, vice-president Cadillac Motor Car Co.; C. C. Hinkley, Hinkley Motors Corp.; O. E. Hunt, engineer Packard Motor Car Co., and Benjamin G. Koether, Hyatt Roller Bearing Co.

Lodge Heads Candler Radiator Co.

DETROIT, Feb. 25—The Chandler Radiator Co. held its annual meeting, at which the following officers were elected: President, John C. Lodge; vice-president, George V. Candler; secretary and manager, John A. Hinger; directors, A. V. Breault, George V. Candler, W. R. Candler, John A. Hinger, James S. Holden, John C. Lodge and D. E. Murray.

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Stout With United Aircraft Corp.

NEW YORK, Feb. 25—W. B. Stout, formerly aircraft engineer of the Packard Motor Car Co., has been appointed sales and aircraft manager of the United Aircraft Engineering Co., New York.

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Col. Edwin S. George has been honorably discharged from the Army, where he acted as chief of the motors branch of the Motors and Vehicles Division, office of Director of Purchase and Storage. He has joined his family in Miami, Fla., and will return to Detroit in April.

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Harmon J. Kline, formerly designing engineer for the Olds Motor Works, Lansing, has been released from the service, where he was a lieutenant in the Ordnance Department, and has joined the engineering staff of the Packard Motor Car Co.

—

Bruce J. Miles, formerly with the Cadillac Motor Car Co., has been made manager of the sales department of the Cadillac unit of the General Motors Export Co., New York City.

—

Joseph C. Faust, director of the production of advertising art for the Packard Motor Car Co., has resigned to become associated with Voelker & Scharfenberg, advertising agency.

—

A. E. Wingert, for three years connected with the sales department of the Chalmers Motor Co., has resigned, effective March 1. He will announce his future plans shortly.

—

C. F. Troupe, who represented the Fisk Rubber Co. in the East and South, has succeeded Frank Lee as sales manager of that company in Wisconsin and upper Michigan.

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C. S. Puttman has been appointed manager of the Detroit branch of the United States Tire Co. He has been with that company since 1911.

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Collier Annual Meeting

BELLEVUE, OHIO, Feb. 22—At the annual meeting of the Collier Motor Truck Co. on Monday, the following officers were elected; President, R. A. Palmer; vice-president, S. H. Penfield; secretary and treasurer, J. F. Corl. M. E. Crow has resigned. Otherwise the Board of Directors was re-elected, including the officers and F. W. Steinen and Charles Matz.

AUTOMOTIVE MATERIALS MARKETS

Materials Market Prices

Acids:
Muriatic, lb. ..... .02 -.03
Phosphoric (85%).. .35 -.39
Su'phuric (60%), lb. .008

Aluminum:
Ingot, lb. ..... .30 -.33
Sheets (18 gage or more), lb. ..... .42
Antimony, lb. ..... .07¼-.07½

Burlap.
8 oz., yd..... .07½
10½ oz., yd..... .10¾-.11

Copper:
Elec., lb. ..... .15½-.16
Lake, lb. ..... .18

Fabric, Tire (17¼ oz.):
Sea Is., combed, sq. yd. 1.50
Egypt, combed, sq. yd. 1.25
Egypt, carded, sq. yd. 1.15
Peelers, combed, sq. yd. 1.10
Peelers, carded, sq. yd. 1.00

Fibre (⅛ in. sheet base), lb. ..... .50

Graphite:
Ceylon, lb. ..... .09 -.22
Madagascar, lb. ... .10 -.15
Mexico, lb. ..... .03¾

Lead, lb. ..... .04⅞-.05⅛

Leather:
Hides, lb. ..... .18 -.34¼

Nickel, lb. ..... .40

Oil:
Gasoline:
Auto, gal. ..... .24½
68 to 70 gal..... .30½

Lard:
Prime City, gal..1.90-2.00
Ex. No. 1, gal...1.10
Linseed, gal. 1.45-1.48
Petroleum (crude):
Kansas, bbl. 2.25
Pennsylv'a, bbl..4.00
Menhaden (dark), gal. 1.05-1.06

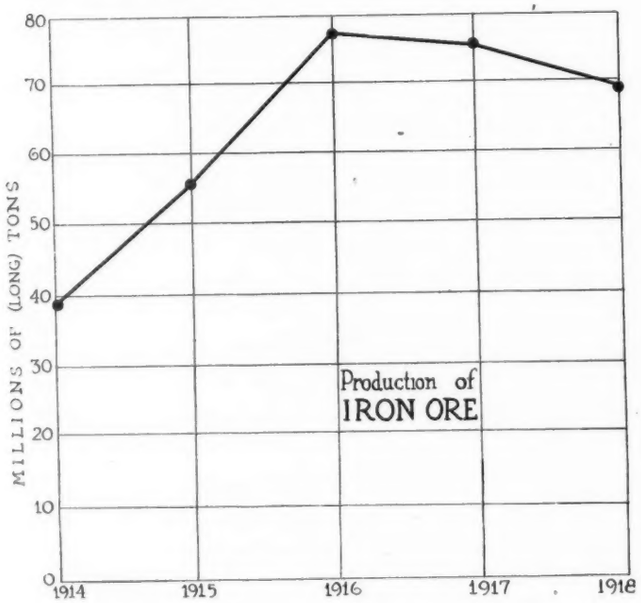
Rubber:
Ceylon:
First latex pa'e crepe, lb. ..... .56 -.56½
Brown crepe, thin, clear, lb. ..... .49
Smoked, ribbed sheets, lb. ..... .56

Para:
Up River, fine, lb. .58½
Up River, coarse, lb. ..... .35

Island, fine, lb..... .49½
Shellac (orange), lb. .60 -.64
Spelter ..... .06½-.06¾

Steel:
Angle beams and channels, lb. .... .03
Automobi'e sheet (see sp. table.)
Cold rolled, lb..... .0625
Hot rolled, lb..... .039

Tin ..... .71 -.72
Tungsten, lb. 1.50-2.10
Waste (cotton), lb... .12¾-.17



Production of iron ore from 1914 *to* 1918

AUTOMOBILE SHEET PRICES

(Based on No. 22 Gage. Other gages at usual differentials)

	Primes only per 100 lbs.	Primes when seconds up to 15 per cent are taken per 100 lbs.
Automobile body stock.....	$5.95	$5.85
Automobile body stock, deep stamping.	6.20	6.10
Automobile body stock, extra deep stamping	6.45	6.35
Hood, flat, fender, door and apron, or splash guard stock.....	6.05	5.95
Crown fender, cowl and radiator casing, extra deep stamping.....	6.55	6.45
Crown fender, cowl and radiator casing, deep stamping.....	6.30	6.20

Automobile Sheet Extras for Extreme Widths:
Nos. 17 and 18 over 36 in. to 44 in., 10c. per 100 lb.
Nos. 19 and 21 over 36 in. to 44 in., 30c. per 100 lb.
Nos. 22 to 24 over 26 in. to 40 in., 40c. per 100 lb.
Nos. 22 to 24 over 40 in. to 44 in., 80c. per 100 lb.

Blank Sheet Extras to Apply to Narrow Widths:
Oiling, 10c. per 100 lb.
Patent leveling, 25c. per 100 lb.

Resquaring, 5 per cent of gage price after quality, finish and size extras have been added.

Seconds 10 per cent less than the invoice Pittsburgh price for corresponding primes.

FOREIGN TRADE OPPORTUNITIES

WASHINGTON, Feb. 21—The Bureau of Foreign and Domestic Commerce, Department of Commerce, has inquiries for the agencies of automobiles and tractors. Full information regarding each of the following can be secured by addressing the Bureau of Foreign and Domestic Commerce, Department of Commerce, and referring to the foreign trade opportunity number.

A firm in India desires to purchase and to secure an agency for the sale of motor cars, tires, tubes and accessories. References have been filed. Foreign Trade Opportunity No. 28,449.

A commercial agency in Honduras desires to represent firms for the sale of farm tractors. Quotations should be made f. o. b. American port. Correspondence may be in English. No. 28,452.

A firm in Italy desires an agency for the sale of farm tractors for work in the mountains as well as on the plains. Correspondence may be in English. References have been filed. No. 28,440.

A company in England desires the sole agency for the sale of automobiles. References have been filed. No. 28,441.

A Belgian importer in England desires an agency for the sale of bicycles, motorcycles, automobiles and tractors. References have been filed. Foreign Trade Opportunity No. 28431.

A man in England wishes to secure an agency for the sale of farm tractors in England and France. References have been filed. No. 28434.

A company is Switzerland wishes to secure an agency for the sale of farm tractors, motor trucks and accessories. No. 28437.

A man in Australia desires an agency for the sale of motor car accessories. References have been filed. Foreign Trade Opportunity No. 28,414.

An agency is desired by a man in Belgium for the sale of motors, automobiles and trucks. No. 28,417.

A firm in Denmark desires an agency for the sale in Poland of automobile accessories. Correspondence may be in English. References have been filed. No. 28,419.

A commercial agent in France wishes to secure an agency for the sale of farm tractors. Correspondence may be in English. References have been filed. No. 28,420.

New Models and Strong Parts Show at Kansas City

(*Continued from page* 494)

ciated with four-wheel-drive is avoided by steering on creeper type; that is by applying a brake to one or the other of the differential shafts. This plan obviates the need for extra differentials and universal joints in the axle shafts. The advantage sought is to make all the weight available for traction.

Heretofore most tractors have been designed specially for use in plowing and other tractor work on the farm has been incidental. It is well known that most other farm operations, such as corn planting, harrowing, disking and hauling, mowers and binders, require much less power than the engine of the conventional three-plow tractor is capable of giving. Hence in doing this work the tractor operates at low efficiency, not only because the engine is running at partial load but more particularly because the power expended in moving the heavy tractor is not commensurate with the power called for by the implement.

Considerations of this nature have induced some makers to bring out tractors of one-plow capacity which, while somewhat at disadvantage in comparison with large machines as regards to plowing, are superior for other work. The lower first cost will make its appeal to the prospect. Single plow tractors are shown by Allis-Chalmers and Indiana.

Motor cultivators are shown in variety for the first time in both single and double-row types. The operator steers by steering wheel and guides the cultivator by pedals, a foot rest not unlike a stirrup being provided on the beams. It is difficult to see the possibilities of a single-row cultivator as its capacity is little greater than a horse one, but it is not necessary to feed it all the year in order to use it for one or two months.

The motor cultivator must necessarily be developed along with the tractor because the corn belt farmer cannot dispense with any of his horses so long as he cannot do both plowing and cultivating by motor. As the two principal crops of the country, corn and cotton, both need it in cultivation the possibilities of this field are enormous.

In conclusion, regarding exhibit of parts at the show, the tractor industry is much more fortunate than was the automobile industry at a corresponding state of its development, considering the variety of highly developed carbureters, magnetos and friction bearings and other standard components the tractor designer has to choose from, and the fact that the makers of these components are so strongly represented at the show indicates that they all anticipate a rapid growth of the tractor industry.

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Entertains Directors of M. A. M. A.

NEW YORK, Feb. 25—Following the usual monthly meeting of the Motor and Accessory Manufacturers Association, C. E. Thompson, president, gave an informal dinner. H. M. Swetland, president of the Class Journal Co., as a guest of Mr. Thompson, talked of his European experiences during the war. He was much impressed by the stability and solidity of the English as based on the principle, "not how quickly but how well" can their plants turn out merchandise.

"Don't overlook the fact, too," said Mr. Swetland, "that the English have learned the value of quantity production, and are now prepared in many lines to produce on a quantity basis articles of high quality." Among other things he mentioned the conferences he attended with leading political and industrial leaders of France and England. He also told of his visit to the great allied fleet, where he was entertained by Admiral Sims, and graphically described scenes in devastated France.

Besides C. E. Thompson, president of the Steel Products Co., and H. M. Swetland, president of the Class Journal Co., there were present: E. H. Broadwell, first vice-president of the M. A. M. A. and vice-president of the Fisk Rubber Co.; E. W. Beach, president of the Manufacturers Foundry Co.; G. W. Yoeman, treasurer of the Continental Motors Corp.; E. P. Hammond, president of the Gemmer Mfg. Co.; C. W. Stiger, president of the Stromberg Motor Devices Co.; A. W. Copland, president of the Detroit Gear & Machine Co.; M. L. Heminway, acting manager, and Sidney S. Meyers, counsel for the M. A. M. A.

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"Aviation Weather" Conditions Reported in England

LONDON, Feb. 11—The announcements of aviation weather conditions appearing daily in a local newspaper show to some extent the progress of British development of aviation commercially.

Forecasts are given on wind, direction and velocity in the upper air, together with reports of similar conditions the previous day. These cover Scotland, England, Ireland, Wales and the Midlands. Under the heading, "Flying Prospects To-day," readers are advised on wind velocity at certain elevations, visibility, cloud formations and other conditions affecting cross-country work within certain areas.

Under another heading, "Aviation Weather," a chart shows the wind direction and velocity in the above sections during the previous day, in the morning, noon and evening, at elevations of 1000 to 15,000 ft. Velocities are given in miles per hour. The cloud-level over the entire British Isles is also added.

A weather chart, supplied by the Meteorological Office, indicates air conditions, temperature, velocity and weather.

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Grease Cups on Cadillac

In AUTOMOTIVE INDUSTRIES on page 249, Jan. 30 issue, the Cadillac car is mentioned as having oil shackle lubrication, whereas grease cups are used and not oil cups.

High Tariffs and Prohibition Hold Industry Back

(*Continued from page* 455)

shut out our low-priced cars unless she is prepared to manufacture such vehicles herself for her tens of thousands who who want them. Her public will not permit of it. The British public, for example, may abide by such prohibition for a time but no government can withstand such a prohibition for long.

In this whole situation of our high tariffs and Europe's prohibition there is too much of the old story of "one's afraid and the other dare not."

Let us grant that European nations who have been at war for 4 years have a right to a period of protection, particularly for the types of cars they make, but should they endeavor to prohibit what they cannot produce and what in many cases they are not contemplating producing.

Europe is not going to the class of production that America has built her reputation on and neither is America going to the class of high-grade workmanship that characterizes European factories in the majority of her production jobs. The result on both sides will be a compromise. We will increase our quality and Europe will increase her production. There is enough room for all, but let us not hold back the market by political moves that serve the more selfish ends of a few but work generally against the good of the many.

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The French Baby Renault Tank

(*Continued from page* 470)

men. A shell which will destroy a Renault 6-ton tank will usually eliminate a 35 or 40-ton tank. But the former, owing to its higher speed, greater handiness and smaller area, is much less liable to be hit than the latter. The personal element counts very considerably in the French army. There is no doubt that a certain weight of armament divided into twenty units, each one of these units being more or less independent and acting on its own initiative, will secure far better results than the same grouped into one or two colossal tanks. Great credit is due to Louis Renault for realizing this important fact.

Used to Haul Canal Barges

Since the signing of the armistice some of the Renault tanks have been made use of for hauling canal barges. Where two horses hauled one barge, a single Renault tank will haul three barges at 25 per cent increase in speed. The suggestion is also made that the tanks be made use of for agricultural work on heavy ground. They appear to be very suitable for this class of work if stripped of their heavy armor plating. The gasoline engine and the reducing gears are completely protected against dust and mud, and only one man is required to handle the machine.

Federal Highway Plan Outlined in Bill

(*Continued from page* 497)

necessary bridges, drainage structures, signs, guardrails, protective structures, and housing.

SEC. 2. That the commission shall consist of five members.

SEC. 3. That the commissioners shall be appointed by the President, by and with the advice and consent of the Senate; not more than three commissioners shall be of the same political party, and shall be chosen from different geographical sections of the United States.

SEC. 4. That the commissioners first appointed shall continue in office for the terms of three, four, five, six, and seven years, respectively, from the date of their appointment; the term of each to be designated by the President, but their successors shall be appointed for the term of seven years, except that any person chosen to fill a vacancy shall be appointed only for the unexpired term of the commissioner whom he shall succeed and have similar qualifications.

SEC. 5. That the commissioners shall receive a salary of $10,000 per annum, payable in the same manner as the judges of the courts of the United States.

SEC. 6. That the commission shall choose a chairman from its own membership. It shall be the duties of the members of the commission to devote the entire statutory time required of other governmental officials to their work.

SEC. 7. That the commission shall appoint a secretary who shall keep a journal of proceedings, minutes of each meeting, record all proceedings, make true copies of all notices to be published, and shall perform such other duties as the commission may designate and require.

SEC. 8. That it shall further have authority and power to employ, at a fixed compensation, a chief engineer, engineers, special experts, attorneys, and clerks as it may from time to time find necessary for the performance of its duties. All other employees of the commission shall be a part of the classified civil service, and shall enter the service under such rules and regulations as may be prescribed by the commission and by the Civil Service Commission.

SEC. 9. That the commission shall have an official seal which shall be judicially noticed.

SEC. 10. That a vacancy in the commission shall not impair the right of the remaining commissioners to exercise all the powers of the commission, and three members of such remaining commissioners shall constitute a quorum.

Shall Select Highways

SEC. 11. That the commission shall select from time to time, subject to such changes as it may deem advisable under the provisions of this act, the highways to be comprised in the National Highway System and shall determine the order in which such highway shall be constructed, reconstructed, and improved. In determining the highways to be comprised in the National Highway System the commission shall request the State highway departments to recommend the routes to be followed in their respective States. The National Highway System shall not include any highway in a place having a population, as shown by the latest available Federal census, of 5000 or more, except that portion of any such highway along which the houses average more than 200 feet apart.

SEC. 12. That the commission shall determine the types of construction and reconstruction and the character of improvement, repair, and maintenance of all highways included in the National Highway System, and shall direct, supervise, and control the making of the surveys, the preparation of the plans, specifications, and estimates, and the construction, reconstruction, improvement, repair, maintenance, and administration of such highways, or may arrange with the State highway departments in their respective States to make the necessary surveys and plans and to pay therefor. Only such durable types and adequate widths of surface shall be adopted for any highway as will effectively meet the traffic conditions thereon and the probable future traffic needs.

SEC. 13. That the Secretary of War may, in his discretion, deliver and turn over to the commission from time to time and without charge therefor, for use in the construction and maintenance of national highways, such vehicles, motor vehicles, road machinery, and equipment as may be suitable for the use of the commission; and the commission is hereby authorized to use the same, in its discretion, in the construction and maintenance of national highways, and to pay the necessary expenses thereof out of the appropriation made under the provisions of this act.

SEC. 14. That no money shall be expended in any State under this act until its legislature shall have assented to the provisions of this act, except that until the final adjournment of the first regular session of the legislature held after the passage of this act the assent of the governor shall be sufficient. In consideration of the benefits to be derived by the State from the construction, reconstruction, improvements, repair, and maintenance of the highways comprised in the National Highways System, and as a condition precedent to the construction of any such highways in any State a right of way therefor, not less than 60 feet in width, except at such points where existing buildings or structures are of such value that the cost of their removal would in the opinion of the commission be excessive, shall be furnished to the United States without expense to it by, for, or on behalf of such State or any civil subdivision thereof. Any land of the United States may be appropriated as rights of way for the highways herein provided for, and the consent of the United States is hereby given to any railroad or canal company to convey to the United States for such highways any part of its right of way acquired by grant from the United States. The highways comprised in the National Highways System shall be constructed, reconstructed, improved, repaired, maintained, and administered entirely at the expense of the United States, except State police powers, but the State or its civil subdivision shall maintain any such highway prior to the construction, reconstruction, or improvement thereof under this act.

Shall Regulate Use of Highways

SEC. 15. That the commission is authorized to prescribe and promulgate such regulations governing the use of highways comprised in the national highway system as the commission may find necessary and reasonable in order to preserve and protect such highways and to facilitate and insure the safety of travel and traffic thereon. Whoever shall wilfully or maliciously injure or destroy any part of a highway embraced in the national highway system or property or material owned or controlled by the United States in connection with such highway, or shall use any such highway or part thereof without complying with the regulations prescribed and promulgated by the commission hereunder, shall be fined not more than $1,000 or imprisoned for not more than one year, or both. Nothing in this act shall affect the jurisdiction of the State, either civil or criminal, over persons and property upon such highways, except so far as the regulation of the use thereof are concerned; that is to say, the State wherein any such highway is situated shall not, by reason of establishment thereof, lose its jurisdiction, nor the inhabitants thereof their rights and privileges as citizens, or be absolved from their duties as citizens of the State.

SEC. 16. That it shall be the further duty of the commission to encourage the proper use of all highways and to stimulate the interests of the States, communities, and rural districts in the most efficient and economical transportation over all highways in the United States, to ascertain by experiment and collect all data on new developments in highway transportation, construction, and maintenance, and to publish the same for the benefit of the people at large.

SEC. 17. That it shall be the further duty of the commission to take over and perform all duties, powers, functions, and other obligations of all Federal agencies having jurisdiction and control of highway and experimental road work and all Federal agencies of educational and investigative character relating to highway transportation. Said departments or agencies shall be so co-ordinated and consolidated as to be made most effective: *Provided, however,* That agencies dealing with all highways under control of the United States Army or Navy in military or naval reservations, or are used solely for military or naval purposes, shall not be so taken over, but shall remain under the jurisdiction and control of said agency.

SEC. 18. That, in addition to the authority conferred by the preceding sections, the commission is authorized to make all rules and regulations necessary for the efficient execution of this act. The commission may let to contract or perform in any other manner which it may deem proper any work under the provisions of this act.

SEC. 19. That, for the purpose of carrying out the foregoing sections of this act there is hereby appropriated out of any money in the Treasury not otherwise appropriated, $50,000,000, which shall become available July 1, 1919, and $75,000,000 for the fiscal year beginning July 1, 1920, and $100,000,000 for each of the three succeeding fiscal years; in all, $425,000,000, which shall be available until expended. Out of such appropriation there shall be available to the commission for each fiscal year, and until expended, such amounts as they may determine to be necessary for the payment of such administrative expenses, including such rent, printing and publications, the purchase of such supplies and equipment, and the employment of such persons and means, and the fixing of compensation therefor, in the District of Columbia and elsewhere, as may be deemed necessary for carrying out the provisions of this act. The amounts so made available to the commission may also be used for the erection and maintenance of buildings outside the District of Columbia and for the operation of housing and subsistence facilities and commissary stores, including the purchase and sale of commodities for the benefit of employees and others engaged upon work under this act, the receipts from such operations and sales to be credited to and become part of appropriation made by this section and to be available for expenditure in the same manner as the remainder of such appropriation. The commission is authorized to purchase, lease, rent, operate, and maintain such motor and other transportation facilities as it may deem necessary in performance of its duties under this act. The commission is authorized and empowered to issue permits, licenses, and franchises for openings in and the use of any portion of the right of way comprised in the national highway system, and may require such payment from the beneficiaries thereof, and in such manner as may seem equitable; and the receipts therefrom shall be credited to the appropriations made by this act, to be expendable in the same manner.

That the commission, after making the deductions authorized by this section, shall apportion the remainder of the appropriation for each fiscal year among the several States in the following manner; One-third in the ratio which the area of each State bears to the total area of all the States; one-third in the ratio which the population of each State bears to the total population of all the States as shown by the latest Federal census; one-third in the ratio which the highway mileage of each State bears to the total mileage of all the States as shown by the official bulletin issued by the Secretary of Agriculture for the year 1914; *Provided,* That if any State desires to immediately improve any section of the national highway within the State, which has been designated by the commission the commission may enter into an agreement with the State highway department of such a State to finance the construction or reconstruction of said highway or section thereof; *Provided, however,* That the amount so advanced shall not exceed the amount apportioned to said State for construction or reconstruction, and the commission shall authorize the repayment to the State highway department of the amount annually set aside for construction or reconstruction until the full amount so advanced has been repaid.

Authorized to Contract for Purchases

SEC. 20. That the commission is authorized to enter into arrangements with any public or private agency for purchase, easements, construction, installation, operation, and maintenance of any facilities which it may consider necessary in the use of the National Highway System, and to pay such part of the cost thereof out of the appropriations under this act as it may deem equitable.

SEC. 21. That in order to increase the effectiveness of an act entitled "An act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes," approved July 11, 1916, said act is hereby amended by enactment of the following provisions:

Section 2 of the act hereinbefore referred to is amended by striking out the word "may" and substituting therefore the word "can."

Paragraph 2 of section 6 of the aforesaid act is hereby amended by striking out the words "nor shall any such payment be in excess of $10,000 per mile, exclusive of the cost of bridges of more than 20 feet clear span."

SEC. 22. That for the purpose of carrying out the provisions of said act as herein amended, there is hereby appropriated, out of any money in the Treasury not otherwise appropriated, in addition to amounts set forth in said act, $25,000,000, which shall become available for expenditure July 1, 1919, and the sum of $25,000,000, which shall become available for expenditure July 1, 1920, which sums shall be expended along with and in the same manner and under the same provisions as directed in the aforesaid act and as herein amended.

SEC. 23. That not later than the first Monday in December of each year the commission shall make a report to Congress showing the operations and expenditures, under the foregoing provisions of this act, for the preceding fiscal year.

SEC. 24. That this act shall be in force from and after the date of its passage.

Calendar

ENGINEERING

S. A. E. Meetings

Feb. 27—Kansas City. S. A. E. tractor meeting at Sweeney School Auditorium; dinner at Hotel Baltimore.
March 5 — Minneapolis Section, S. A. E.—Hotel Radisson. "Tractor Service and Sales."
March 7—New York. S. A. E. Aircraft Meeting at Engineering Societies Bldg.
April 2—Minneapolis Section, S. A. E. — Hotel Radisson. "Implements Designed for Tractor Belt Power and Their Characteristics."

SHOWS

Feb. 22-March 1 — Hartford, Conn. Hartford Automobile Dealers' Assn., Inc., Broad Street Armory. Ben F. Smith, Manager.
Feb. 22-March 1—Atlantic City, N. J. Auto Trades Assn. of Atlantic City.
Feb. 22-March 1—New Castle, Pa., Lawrence County Association of Automobile and Accessory Dealers.
Feb. 22-March 1—Reading, Pa. Reading Auto. Trade Assn.
Feb. 23-March 1—Cedar Rapids. Auditorium, Automobile Dealers' Assn.
Feb. 24-March 1—Burlington, Ia. Second Annual.
Feb. 24-March 1—Kansas City, Mo.—Kansas City Motor Dealers' Assn. E. E. Peake, Manager.
Feb. 24-March 1—Springfield, Mass. Automobile Dealers' Assn. Harry W. Stacy, Manager.
Feb. 24-March 1—Springfield, O. Auto. Trade Assn.
Feb. 24-March 1—Portland, Ore. Ninth Annual Dealers' Motor Car Assn., Automobile Palace. M. O. Wilkins, Manager.
Feb. 24-March 1—Duluth, Minn. Duluth Automobile Dealers' Assn.
Feb. 25-March 1 — Erie, Pa., United States Garage.
Feb. 26-March 1—Mason City, Ia. Fifth Annual, Mason City Auto Show Assn.
Feb. 26-March 1—Madison, Wis. Seventh Annual, Automobile Dealers' Division of Madison Assn. of Commerce, Union Transfer Bldg.
Feb. 26-March 1—Quincy, Ill. Cars, Quincy Automobile Trade Assn. Armory.
Feb. —Wheeling, W. Va. Automobile Show at Market Auditorium.
March 1-8—York, Pa.
March 1-8—Detroit, Mich. Detroit Automobile Dealers' Assn. H. H. Shuart, Manager.
March 1-15—New York Aeronautical Exhibition, Manufacturers' Aircraft Assn., Madison Square Garden and 69th Regiment Armory.
March — Scranton, Pa. Thirteenth Regiment Armory, Scranton Automobile Assn.
March—Utica, N. Y. Utica Motor Dealers' Assn. W. W. Garabrandt, Manager.
March—Philadelphia, Pa. Philadelphia Automobile Trade Assn. Passenger cars.
March 3-4—Bristol, Conn. First Annual, Bristol Automobile Dealers' Assn., Armory.
March 3-5—Quincy, Ill. Trucks and Tractors. Armory.
March 3-8 — Muskegon, Mich. Third Annual, Armory, Muskegon Lodge No. 274, B. P. O. E. John C. Fowler and George M. Friant, Managers.
March 3-8—Dayton, O., N. A. C. A. Building.
March 3-8—Columbus, O. Columbus Automobile Show Co., Memorial Building. W. W. Freeman, Manager.
March 3-8—Raleigh, N. C. Third Annual. H. B. Bolton, Manager.
March 3-8—Scranton, Pa. Ninth Annual, 13th Regiment Armory, Scranton Automobile Assn. Hugh B. Andrews, Manager.
March 3-8—Buffalo, N. Y. Buffalo Automobile Dealers' Assn.
March 3-8—Richmond, Va. Third Annual, Richmond Automobile Trade Assn., Gray's Armory.
March 3-8 — Worcester, Mass. Annual Show, Casino Auditorium.
March 5-8—Lancaster, Pa. Automobile Trade Assn., Rowe Motor Co.'s Bldg. R. W. Shreiner, Manager.
March 8-15 — New Brunswick, N. J. Armory, New Brunswick Motor Trade Assn. William Kuehle, Manager.
March 8-15 — Philadelphia, Pa. Philadelphia Automobile Trade Assn., Commercial Museum. A. L. Maltby, Manager.
March 10-12 — Lancaster, Pa. Truck Show.
March 10-15—Paterson, N. J. Paterson Automobile Trade Assn., Fifth Regiment Armory. H. MacGinley, Show Manager.
March 10-15 — Salt Lake City, Utah. Sixth Annual, Bonneville Pavilion. W. D. Rishel, Manager.
March 10-15—Syracuse, N. Y. Syracuse Automobile Dealers' Assn. Harry T. Gradner, Manager.
March 10-15 — Omaha, Neb. Fourteenth Annual, Omaha Automobile Trade Assn., Auditorium. Clark G. Powell, Manager.
March 12-18—Peoria, Ill. Passenger cars, 12 to 15; trucks, 17 and 18.
March 15-22 — Boston, Mass. Boston Automobile Dealers' Assn. Passenger cars only. Chester I. Campbell, Manager.
March 15-22—Harrisburg, Pa. Harrisburg Motor Dealers' Assn., Overland Warehouse. J. Clyde Myton, Manager.
March 17 - 22 — Great Falls. Mont. Montana Automobile Distributors' Assn.
March 17-22—Philadelphia, Pa. Motor Truck Assn., Commercial Museum.
March 19-22—St. Joseph, Mo. St. Joseph Automobile Show Assn., Auditorium. John Albus, Manager.
March 19-22—Norfolk, Neb. Norfolk Automobile Show Assn.
March 19-22—Warren, Pa. Third Annual, Warren Automobile Dealers' Assn.
March 22-29—Pittsburgh Automobile Dealers' Assn. of Pittsburgh. John J. Bell, Manager.
March 22-29—Passenger Cars. April 1-5—Trucks, Brooklyn. Brooklyn Motor Vehicle Dealers' Assn. I. C. Kirkman, Manager.
March 24-29—New Orleans, La. Henry B. Marks, Manager.
March 24-29—Greenfield, Mass. Greenfield Automobile Dealers' Assn., State Armory. James J. Callahan (Pittsfield) Manager.
March 24-29—Utica, N. Y. Utica Motor Dealers' Assn.
March 26-29—Watertown, N. Y. Tenth Annual, State Armory, Automobile Dealers, Inc. Arthur E. Sherwood, Manager.
March 28-30—Peru, Ill. Illinois Valley Auto Show.
Third week March—Trenton, N. J. Trenton Auto Trade Assn. John L. Brock, Manager.
April 5-12 — Bridgeton, N. J. Fourth Annual, Automobile Dealers' Assn.
April 5-12—Montreal, Can.—National Motor Show of Eastern Canada, Victoria Rink. T. C. Kirby, Manager.
April 13-19—Bristol, Tenn. Cars, trucks, tractors, airplanes and accessories. Bristol Chamber of Commerce.
April 14-19—Bristol, Va.-Tenn. Cars, Trucks, Tractors. C. W. Roberts, Manager.
Not decided—Bridgeport, Conn. Auspices of City Battalion. B. B. Steiber, Manager.
Not decided—Indianapolis, Ind. Indianapolis Auto Trade Assn. John B. Orman, Manager.
June 2-6—Hot Springs, Va. Convention, Automotive Equipment Assn., Homestead Hotel.

TRACTOR SHOWS

Feb. 24-March 1—Kansas City, Mo. Fourth Annual Tractor Show. Sweeney Building, Kansas City Tractor Club. Guy H. Hall, Sec.

RACES

March 15—Santa Monica, Cal. Speedway.
March 23—Los Angeles. Ascot Speedway Assn., Ascot Speedway, 150 miles.
May 17—Uniontown, Pa., probably 112½ miles.
May 31—Indianapolis. Indianapolis Motor Speedway Assn., 500 miles.
July 5—Cincinnati, O., Speedway.
July 19—Uniontown, Pa. Speedway race.
July 26—Sheepshead Bay, L. I. Speedway race.
Aug. 22-23—Elgin, Ill. Speedway.
Aug. 23—Sheepshead Bay, L. I. Speedway race.
Sept. 1—Uniontown, Pa. Speedway race.
Sept. 20—Sheepshead Bay, L. I. Speedway race.
Oct. 1—Cincinnati, O. Speedway race.

CONVENTIONS

Feb. 25-28—New York. Sixteenth Annual Convention. American Road Builders' Assn.
Feb. 25-28 — Ninth American Good Roads Congress and 16th Annual Convention of the American Road Builders' Assn. Hotel McAlpin, New York.
March 3-4—Pueblo, Col. Convention Rocky Mt. Auto Trades Assn.
March 7—Automobile Export Managers Convention, N. A. C. C. headquarters, New York.
April 10-12—Philadelphia. National Assn. of Motor Truck Sales Mgrs., Bellevue-Stratford.
April 24-26—Chicago — National Foreign Trade Council. Sixth National Foreign Trade Convention. Congress Hotel.

War Department May Lend Aviation Engines for Educational Work

WASHINGTON, Feb. 24—The Senate has passed an amendment authorizing the loan of aviation engines and aircraft material to educational institutions. Two or three such institutions, including the College of the City of New York, have requested the War Department to lend them Liberty engines for the use of students. The War Department was willing to do this, but has not had the authority. By this amendment the War Department has authority to make such loans at its own discretion, reserving to the Government the title to the motors and all other material.

The text of the resolution reads as follows:

"That the Secretary of War is hereby authorized and empowered, for the purpose of aiding, fostering and promoting educational experimentation work, to loan aircraft motors and aircraft equipment to such educational institutions in the United States as provide advanced mechanical and technical instruction, under such rules and regulations as the Secretary of War may prescribe."

The amendment was agreed to and the joint resolution was reported to the Senate as amended. The amendment was concurred in by the members of the Upper House and passed.

Air Information by the A. A. A.

NEW YORK, Feb. 25—The American Automobile Assn., which has for years made and provided maps for motorists, has now added the production of air maps for flying, and will show at the aeronautical exhibition gigantic maps of the United States with the established air lanes, landing fields and prominent landmarks, together with compass readings. It will also display strip maps adapted to the needs of the aviator. An aero map of Long Island will be seen for the first time. Permission has also been secured to display some of the special Government aerial maps which the organization helped to prepare.